Computer Interfacing Manual

arroyo instruments

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Introduction

The *Computer Interfacing Manual* provides a complete summary of all commands supported by the Arroyo Instruments line of products. While in remote control mode, the computer interface allows full operation of the instrument, plus advanced features only available via the computer interface.

You will find in reviewing the command set that it is largely compatible with both ILX and Newport laser diode drivers and temperature controllers. In fact, for many applications, you can use an Arroyo Instruments controller in place of a Newport or ILX instrument with little to no change in the commands used to control the instrument.

The RS232 Interface

Some instruments provide a RS232 serial interface, a common, easy-to-use interface for controlling the instrument. With baud rates up to 115k baud, high-speed control and measurement is possible.

Cable Connections

The RS232 interface is a male DB9 pinned identically to a standard PC RS232 port, so a female/female cable in NULL modem configuration (transmit and receive pins swapped) is required. The full pin-out is described below:

Pin	Description
2	Receive
3	Transmit
5	Ground
Shell	Earth ground

RS232 Connector (DB-9 Male)

Depending on if you are connecting to a DB9 or DB25 on the PC, follow the pin-to-pin assignments in the table below.

Instrument	PC DB9	PC DB25
2	3	2
3	2	3
5	5	7

Instrument to PC pin assignment

Interface Settings

Baud Rate	The instrument will operate at 300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200 baud rates. The baud rate can be set through the instrument's menu, with a factory default of 9600, and must match the setting on the PC
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

Ensure to disable flow control. Failure to do so will prevent the instrument from sending data back to the PC.

The USB Interface

Because of its speed, expandability, and commonality, the USB interface has become the interface of choice for newer PC-connected devices. Unlike GPIB, USB uses inexpensive cables and allows up to 127 devices to be connected to a single USB master.

Using the Arroyo Instruments USB Interface

To keep complexity to a minimum, once you have installed the USB drivers, the instrument will appear as a virtual serial port that you can use just like a normal serial port. In this way, you can communicate to the instrument without requiring special software modifications to your existing applications.

Loading the Software Drivers

Unlike the RS232 interface, using the USB interface requires software drivers (provided on the CD with your instrument or available over the Microsoft Windows Update service) to be loaded onto your PC. Follow the instructions in your instrument manual for installing the USB drivers.

Once a COM port has been assigned to an instrument, it will continue to use the same COM port unless it is reassigned through the Control Panel.

Cable Connections and Interface Settings

The Arroyo controller uses a full-size USB Type B socket. You may use any USB 1.1 or 2.0 certified cable. The baud rate is fixed at 38,400.

Baud Rate	38400
Parity	None
Data Bits	8
Stop Bits	1
Flow Control	None

Ensure to disable flow control. Failure to do so will prevent the instrument from sending data back to the PC.

Arroyo Control

ArroyoControl is a free software program that is included on the disc that comes with your instrument, and provides remote control of all Arroyo Instruments' controllers. If you are having problems communicating with the instrument, it can be a useful diagnostic step to install and use ArroyoControl to see if the program can successfully communicate with the instrument. If it does, then it demonstrates that the connection and drivers are properly installed.

Using Commands

While the instrument does not have a GPIB interface, the command structure and parsing were developed around the IEEE-488.2 standard. Most IEEE-488.2 commands are supported, and the command/response format is consistent with the standard.

When sending commands to the instrument, you must terminate the command string with a carriage return (ASCII 13) or line feed (ASCII 10, or both. The instrument will not start processing a command, or go into remote mode until it has received a carriage return or feed command terminator.

Commands are grouped into two major categories: device-independent and device-dependent commands. Device-independent commands include all the IEEE-488.2 supported commands plus other commands that are universal across all instruments. Device-dependent commands are specific to a class of instruments, such as TEC commands for the temperature controller. Not all instruments support every command. Review the command for instrument-specific differences.

IEE-488.2 Commands

The following device-independent commands are supported by most instruments:

*CLS	*IST?	*PSC	*SRE
*ESE	*OPC	*PSC?	*SRE?
*ESE?	*OPC?	*RCL	*STB?
*ESR?	*PRE	*RST	*WAI
*IDN?	*PRE?	*SAV	

Device-Independent Commands

The following device-independent commands are supported by most instruments:

BAUD	ERRSTR?	RADix?	TERM
BEEP	HEXFLOAT	REMERR	TERM?
BEEP?	HEXFLOAT?	REMERR?	TERMINAL
BRIGHT	LOCAL	REMSET	TERMINAL?
BRIGHT?	MESsage	REMSET?	TIME?
CALdate?	MESsage?	SCRIPT:GET	TIMER?
DELAY	ONDELAY	SCRIPT:GO	VER?
EQUIPment?	ONDELAY?	SCRIPT:PUT	
ERRors?	RADix	SN?	

Device-Dependent Commands

Device-dependent commands are specific to a class of instruments, such as the temperature controller.

Many of the device dependent commands have two commands that do the same thing. For example, LAS:I? and LAS:LDI? perform the same operation. The “I”, “IPD”, and “Ppd” forms of commands are considered obsolete but are included for compatibility reasons.

Laser Command List

LASer:AUX?	LASer:CONST?	LASer:DELAYOUT?
LASer:CABLER	LASer:DC	LASer:DISplay
LASer:CABLER?	LASer:DC?	LASer:DISplay?
LASer:CALMD (CALPD)	LASer:DEC	LASer:ENABle:COND
LASer:CALMD? (CALPD?)	LASer:DELAYIN	LASer:ENABle:COND?
LASer:COND?	LASer:DELAYIN?	LASer:ENABle:EVEnt
LASer:CONST	LASer:DELAYOUT	LASer:ENABle:EVEnt?

LASer:ENABle:OUTOFF
LASer:ENABle:OUTOFF?
LASer:EVEnt?
LASer:F
LASer:F?
LASer:INC
LASer:INTCONT
LASer:INTCONT?
LASer:LDI (I)
LASer:LDI? (I?)
LASer:LDIRES
LASer:LDIRES?
LASer:LDIRESAVAIL?
LASer:LDV
LASer:LDV?
LASer:LIMit:LDI (I)
LASer:LIMit:LDI? (I?)
LASer:LIMit:LDV
LASer:LIMit:LDV?
LASer:LIMit:MDI (IPD)
LASer:LIMit:MDI? (IPD?)
LASer:LIMit:MDP (Ppd)
LASer:LIMit:MDP? (Ppd?)
LASer:LIMit:RHIgh
LASer:LIMit:RHIgh?
LASer:LIMit:RLOw
LASer:LIMit:RLOw?
LASer:LIMit:THIgh
LASer:LIMit:THIgh?
LASer:LIMit:TLOw
LASer:LIMit:TLOw?
LASer:MDI (IPD)
LASer:MDI? (IPD?)
LASer:MDP (Ppd)
LASer:MDP? (Ppd?)
LASer:MODE?
LASer:MODE:BURST
LASer:MODE:ICW (CW)
LASer:MODE:ILBW (I)
LASer:MODE:IHBW
LASer:MODE:LDV
LASer:MODE:MDI (IPD)
LASer:MODE:MDP (Ppd)
LASer:MODE:PULSE
LASer:MODE:TRIG
LASer:OUTput
LASer:OUTput?
LASer:PDBias
LASer:PDBias?
LASer:PW?
LASer:PWF
LASer:PWP
LASer:QCWHOLD
LASer:QCWHOLD?
LASer:QCWCOUNT
LASer:QCWCOUNT?
LASer:R?
LASer:RANGE
LASer:RANGE?
LASer:SET:LDI? (I?)
LASer:SET:LDV?
LASer:SET:MDI? (IPD?)
LASer:SET:MDP? (Ppd?)
LASer:STB?
LASer:STEP
LASer:STEP?
LASer:T?
LASer:TOLerance
LASer:TOLerance?
LASer:TRIGger
LASer:USERCAL:EDIT
LASer:USERCAL:EDIT?
LASer:USERCAL:GET?
LASer:USERCAL:GETALL?
LASer:USERCAL:PUT
LASer:USERCAL:RESET
LASer:VSENSE
LASer:VSENSE?

TEC Command List

TEC:ACTIVESENsor
TEC:ACTIVESENsor?
TEC:ANALOG:MODE
TEC:ANALOG:MODE?
TEC:ANALOG:OUT
TEC:ANALOG:OUT?
TEC:ANALOG:RES
TEC:ANALOG:RES?
TEC:ANALOG:THIGH
TEC:ANALOG:THIGH?
TEC:ANALOG:TLOW
TEC:ANALOG:TLOW?
TEC:AUTOTUNE
TEC:AUTOTUNE?
TEC:AUTOTUNESTATE?
TEC:CABLER
TEC:CABLER?
TEC:CABLETYPE?
TEC:COND?
TEC:CONST
TEC:CONST?
TEC:CONSTIDX
TEC:CONSTIDX?
TEC:DEC
TEC:DIO:IN?
TEC:DIO:INMODE
TEC:DIO:INMODE?
TEC:DIO:OUT?
TEC:DIO:OUTMODE
TEC:DIO:OUTMODE?
TEC:DISplay
TEC:DISplay?
TEC:ENABle:AUXLIMITS
TEC:ENABle:AUXLIMITS?
TEC:ENABle:COND
TEC:ENABle:COND?
TEC:ENABle:EVEnt
TEC:ENABle:EVEnt?
TEC:ENABle:NONACTIVELIMITS
TEC:ENABle:NONACTIVELIMITS?
TEC:ENABle:OUTOFF
TEC:ENABle:OUTOFF?
TEC:EVEnt?
TEC:FAN
TEC:FAN?
TEC:GAIN
TEC:GAIN?
TEC:HEATCOOL
TEC:HEATCOOL?
TEC:INC
TEC:ITE
TEC:ITE?
TEC:INVERTITE
TEC:INVERTITE?
TEC:LIMit:ITE
TEC:LIMit:ITE?
TEC:LIMit:RHI
TEC:LIMit:RHI?
TEC:LIMit:RLO
TEC:LIMit:RLO?
TEC:LIMit:THI
TEC:LIMit:THI?
TEC:LIMit:TLO
TEC:LIMit:TLO?
TEC:MODE?
TEC:MODE:ITE
TEC:MODE:R
TEC:MODE:T
TEC:MOUNT
TEC:MOUNT?
TEC:OUTput
TEC:OUTput?
TEC:PID
TEC:PID?
TEC:R
TEC:R?
TEC:SENsor
TEC:SENsor?
TEC:SET:ITE?
TEC:SET:R?
TEC:SET:T?
TEC:STB?
TEC:STEP
TEC:STEP?
TEC:T
TEC:T?
TEC:TOLerance
TEC:TOLerance?
TEC:TRATE
TEC:TRATE?
TEC:TSTEP
TEC:TSTEP?
TEC:USERCAL:EDIT
TEC:USERCAL:EDIT?
TEC:USERCAL:GET?
TEC:USERCAL:GETALL?
TEC:USERCAL:PUT
TEC:USERCAL:RESET
TEC:V?
TEC:VSENSE
TEC:VSENSE?

Command Syntax and Concatenation

All commands use a common syntax for constructing the command and parameter passing. Commands are case-insensitive, and some commands have optional characters, which are denoted as lower-case characters in the command definition. For example, LASer:EVEnt? can be shortened to LAS:EVE? This allows for command abbreviation and therefore reduced communication times.

The input buffer of the instrument allows for up to 128 characters to be received before a command overflow error occurs. If a command overflow does occur, the entire buffer is discarded and an E-102 (Message too long) error will occur.

If a command requires one or more parameters, place a space between the command and the first parameter, then use a comma to separate additional parameters. For example, the laser tolerance command might look like:

```
LASER:TOLERANCE 10,25
```

It is also possible to concatenate multiple commands together as a single communication to the instrument. By using a semicolon, multiple commands can be sent to the instrument at once, but command processing will not start until all commands and the command terminator have been received. For example, to set the laser set point to 10mA and turn the output on, the command would look like:

```
LASER:LDI 10; LASER:OUTPUT 1
```

Command Paths

The command set is structured in a tree-like organization, where commands for a common device or function are grouped together. For example, all commands specific to the laser driver start with a “LASer:” prefix. This is called the command path.

When issuing multiple concatenated commands to the instrument, it “remembers” the command path of the previous command, and allows you to omit the common path from the second command. Using the example above where the set point was changed to 10mA and the output turned on, it could also be shortened by omitting the second “LASER:” portion because when the OUTPUT command is processed, the command parser “remembers” it’s position in the command tree and starts looking for the command at that level. The command could therefore be shortened to this:

```
LASER:LDI 10;OUTPUT 1
```

Removing the optional characters from the commands, you can further shorten the command to:

```
LAS:LDI 10;OUT 1
```

In the case where the same command exists at the last command level and in one or more levels above, you can start the command with a colon (‘:’) to force the command parser to start at the root. For example, take the following command:

```
LASER:MODE:LDV;LDV 0.5
```

At first glance, it appears to set the laser into voltage control mode and then set the set point to 0.5V. However, after processing the first command, the parser is at the “LASER:MODE:” level in the command tree and the second “LDV” command will match the “LASER:MODE:LDV” command, basically changing modes twice. To force the parser to interpret the command the way we intended, compose the second command after the semicolon like this:

```
LASER:MODE:LDV; :LASER:LDV 0.5
```

Numeric Substitutions

For command readability, you can also substitute alternate values for zero (0) and one (1). “0” can be replaced by “OFF”, “NEW”, or “FALSE”. “1” can be replaced by “ON”, “OLD”, or “TRUE”.

Working with Radixes and Hex Floats

It is possible to change the base coding of decimal values to binary, octal, or hexadecimal (hex) by using the RADIX command. Depending on your programming interface, it may be easier to send or receive data in one of these alternate notations.

The RADIX command only affects data sent by the instrument to the PC; the instrument will always accept values in alternate base values.

Hex values are prefixed with a ‘#H’, octal with a ‘#O’, and binary with a ‘#B’. For example, the decimal value 47635 would be represented as following:

Binary:	#B1011101000010011
Octal:	#O135023
Hexadecimal:	#HBA13

In addition to the binary, octal, and hex, floating point numbers can be transmitted and received in a ‘ASCII-hex’ notation. Transmission of floating-point values over plain text interfaces (such as is used on Arroyo controllers) invariably leads to rounding of the floating point number simply because the plain text interface does not (typically) transmit the full resolution a floating point number is capable of. This does not normally affect operation, and commands to the Arroyo controllers can always include additional resolution to mitigate this.

However, in some applications, it is useful to have the *exact* floating point value, and the hex float mode enables this. When operating in hex float mode, floating point numbers are transmitted in IEEE 754 notation, starting with a ‘#E’ prefix.

For example, the single-precision float point value 123.45 would be encoded as #E42F6E666. For double-precision values, the hex data would be twice the length, and 123.45 in double-precision hex data would be #E405EDCCCCCCCCCCD.

While the instrument will always accept floating point numbers encoded in hex float, the HEXFLOAT command enabled the transmission of hex float values from the instrument to the PC for those values that are represented in floating point notation (such as measurements and set points). Non-floating point numbers will continue to transmit normally (or in alternate base if selected by the RADIX command).

See http://en.wikipedia.org/wiki/IEEE_754-1985 for additional information on the IEEE 754 format. See http://babbage.cs.qc.edu/IEEE-754/ for an online tool to convert to/from hexadecimal values.

Working with Scripts

Script support was added with version 2 of the firmware. It is normally used to load scripts for execution by the instrument's function keys, but scripts can also be executed remotely.

A script is a series of commands, anything you can normally send to the instrument, but stored in memory for execution at a later time. A script can contain any valid command except:

- DELAY
- *WAI
- SCRIPT:GO
- SCRIPT:PUT

A script can be a maximum of 200 characters and up to four scripts can be stored.

A script can contain more than one command, but there is a slight difference when concatenating commands as compared to normal communications: instead of using a semicolon (;) to separate commands, you must use a carat (^). For example, a script to change the set point to 50mA and turn the output on, stored in position 1, would be stored with the following command:

```
SCRIPT:PUT 1, LAS:I 50^LAS:OUT ON
```

Notice that a carat separates the two commands, not a semicolon. You can then execute the script remotely with the SCRIPT:GO command:

```
SCRIPT:GO 1
```

If your instrument has function keys, you can also assign the script to the function key.

Event and Condition Reporting

In order to allow for quick summary reporting of device status, the instruments contain a powerful status reporting structure, which can be configured to report status at several levels of the instrument's operation. Using the various enable registers, a summary of the instrument's operation is made into the status byte register, allowing the control application to query only the status byte register, and if no pertinent events or conditions are being reported, no other status checking is needed.

In some cases, condition and event registers may appear to report the same thing, but it is how the registers work that make them unique from each other. A condition register will report the status of the instrument at the moment in time when the condition register is queried. For fast conditions (such as laser over-voltage), it's not possible to detect the condition no matter how fast you query the instrument. This is where event registers come in: they "remember" their state until you read them. For example, if a laser goes into current limit, then out of current limit, its condition register will indicate current limit only while it is in that state. The event register, however, will set its current limit bit, and that bit will remain set until the event register is read. All event registers, once read, will automatically reset themselves to zero.

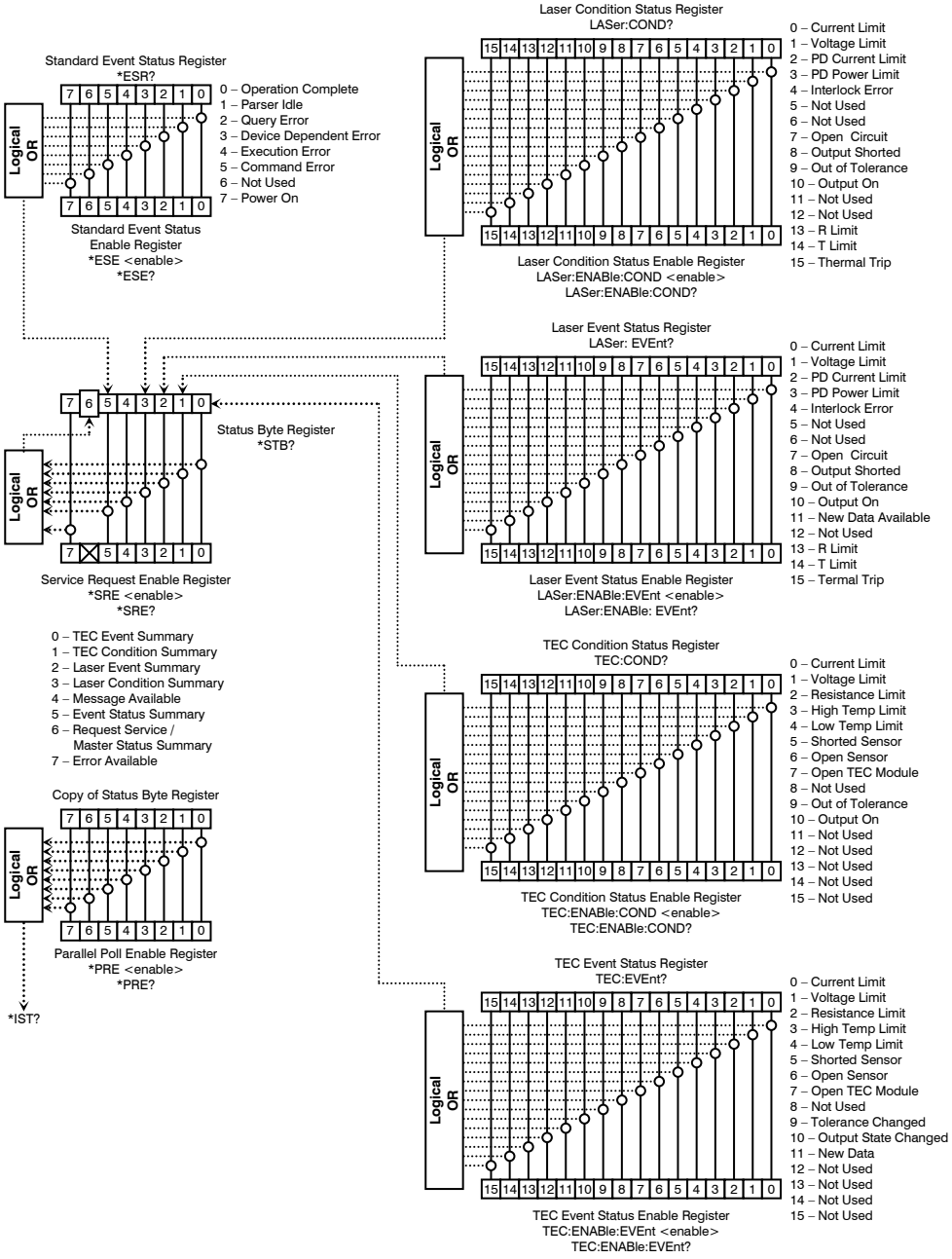
For example, if you wanted to monitor if the laser was in current or power limit, if the output turned off, or if there were any error in the error queue, you could enable reporting of current or power limit conditions in the LASer:COND register, and enable the output status change event in the LASer:EVEnt register. By querying the status byte register (*STB?), no further action is necessary if the laser event, laser condition, and error available bits were all zero. If you did not use the status reporting system, you would need to issue at least three commands to do the same thing.

At first glance, the reporting structure pictured below can seem complex, but it is actually quite simple. For each register, there is a corresponding enable register. For example, the laser condition register (LASer:COND) has a laser condition enable register (LASer:ENABle:COND). The two registers are ANDed together, and if the resulting value is non-zero , then the corresponding bit in the status byte register is turned on (in this case, bit 3, the laser condition summary bit).

By reviewing your application needs and the reporting capabilities of the system, you can determine what conditions or event you want to enable and appropriately set each of the enable registers.

In USB and RS232 applications, the Service Request Enable Register, the Parallel Poll Enable Register, and the IST bit have little value because the Status Byte Register will contain more detail, but these registers have been implemented for greater compatibility with existing software applications.

Instrument Status Reporting Structure



Operation Complete Definition

The term “Operation Complete” is a summary condition which indicates that the instrument is has reached a stable, idle operating condition. This includes reaching temperature equilibrium, completing any ramp functions, and other, similar actions which take some amount of time to complete.

This condition is reported in bit 0 of the Standard Event Status Register as the Operation Complete flag, and is also used to control the execution of the *OPC, *OPC?, and *WAI commands. Using the *ESE command, the user can also update bits of the Status Byte Register.

Operation Complete is defined as:

1. The laser controller is idle (no ramp functions).
2. The TEC controller is idle (no ramp functions).
3. No EPROM (non-volatile) memory write cycles are in progress.
4. No delay timeout clocks are running.
5. No calibration routines are running.
6. Laser output is off, or it is on and within tolerance.
7. TEC output is off, or it is on and within tolerance.

Primary and Auxiliary Sensors

Many of the TEC commands include a parameter called “sensor index”. This index is used to select the sensor to which the command will change or query.

Some commands are specific to primary or auxiliary sensors. A primary sensor is one that can be used in the control loop to control the temperature of the mount or device. An auxiliary sensor is one that can only be used to monitor a temperature sensor.

For instruments with only a single temperature sensor input, that sensor input is the primary and active sensor, and the sensor index will always be one.

For multi-sensor controllers with more than one primary sensor, only one sensor input can be used to control the temperature, and this is considered the “active” sensor. Other primary sensors not involved in temperature control are called “non-active” primary sensors.

For many commands, the sensor index argument is optional. If omitted from the command, then the sensor index of the primary active sensor is used. This maintains backwards compatibility with existing control programs.

Alphabetical List of Commands

*CLS

Synopsis Clear status registers command

Syntax *CLS

Details Clears the standard event status register, all event registers, and the error queue.

See Also ESR?, ERR?, *IST?, *STB?

*ESE

Synopsis Set the Event Status Register Enable

Syntax *ESE *mask*

Details See the ESR? query for a definition of the individual bits with the *mask* parameter. The *mask* is logically ANDed with the ESR register, and if any of the resulting bits are high, bit 5 of the STB register (Event Status Summary) is set.

See Also *ESE?, ESR?, *STB?

*ESE?

Synopsis Query the Event Status Register Enable

Syntax *ESE?

Details Returns the value of the Event Status Register Enable. See the ESR? query for a definition of the individual bits with the response value.

See Also *ESE, ESR?, *STB?

*ESR?

Synopsis Query the Event Status Register

Syntax *ESR?

Details Returns the value of the Event Status Register. As with all event registers, after the value has been read, the register will be set to zero.

Response	Bit	Value	Description
ESR	0	1	Operation complete
	1	2	Parser idle: the parser buffer is empty
	2	4	Query error (errors 300 through 399)
	3	8	Device dependent error (errors 400 through 599)
	4	16	Execution error (errors 200 through 299)
	5	32	Command error (errors 100 through 199)
	6	64	Not Used
	7	128	Power on: the unit has been powered on since the last time this register was read or cleared.

Operation complete indicates when the controller has completed all pending operations and the outputs are stable.

See Also *ESE, ESE?, *OPC, *STB?

---

*IDN?

Synopsis Query the instrument identification

Syntax *IDN?

Details Returns the identification string for the instrument in the following format:

Arroyo *Model SN Ver Build*

Response	Description
Model	The model number of the product, such as '4205'.
SN	The serial number.
Ver	The firmware version.
Build	Internal build number.

---

*IST?

Synopsis Query Individual Status

Syntax *IST?

Details Returns the value of the 'ist' bit within the reporting structure.

Response	Value	Description
ist	0	ist false
	1	ist true

See Also *PRE, *STB

---

*OPC

Synopsis Operation Complete Command

Syntax *OPC

Details Sets the operation complete bit in the event status register when the operation complete state is true.

See Also *ESR?, *OPC?, *WAI

---

*OPC?

Synopsis Operation Complete Query

Syntax *OPC?

Details Returns a "1" when the operation complete state is true. The "1" will be inserted asynchronously upon operation complete.

See Also *OPC, *WAI

*PRE

Synopsis Set the Parallel Poll Enable Register

Syntax *PRE *mask*

Details See the STB? query for a definition of the individual bits with the *mask* parameter. The *mask* is logically ANDed with the Status Byte Register, and if any of the resulting bits are high, the 'ist' bit is set.

See Also *PRE?, *STB?

*PRE?

Synopsis Query the Parallel Poll Enable Register

Syntax *PRE?

Details Returns the value of the Parallel Poll Enable register. See the STB? query for a definition of the individual bits with response value.

See Also *PRE, *STB?

*PSC

Synopsis Set the Power-On Status Clear

Syntax *PSC *enable*

Details Enables or disables the power-on clearing of event and condition status enable registers.

Argument	Value	Description
enable	1	All event and condition status enable registers are cleared at power-up.
	0	All event and condition status enable registers are restored their last power-off state.

See Also *PSC?

*PSC?

Synopsis Query the Power-n Status Clear

Syntax *PSC?

Details Returns the value of the Power-On Status Clear register. See the *PSC command for a definition of the response value.

See Also *PSC

*RCL

Synopsis Recall command

Syntax *RCL *bin*

Details The *RCL command is used to restore the unit from a saved configuration bin. Bin 0 is a special case, and behaves identically to a *RST command. A configuration recall from an empty bin will generate an error.

Argument	Value	Description
bin	0	Reset to factory configuration, same as *RST command.
	1 to 4	Recall configuration saved via *SAV command.

See Also *RST

*RST

Synopsis Reset command

Syntax *RST [*all*]

Details Resets the instrument parameters to factory defaults, and the output is shut off. The unit remains in remote mode. To erase saved configurations, function key assignments, and scripts, the optional *all* parameter must be set to 1.

Note that user calibration parameters are not changes with any form of the *RST comment. They must be reset with the appropriate USERCAL:RESET command.

Argument	Value	Description
all	0	Reset to parameters to factory configuration, ***excluding*** saved configurations, function key assignments, and scripts.
	1	Reset to parameters to factory configuration, ***including*** saved configurations, function key assignments, and scripts.

See Also *RCL, LASER:USERCAL:RESET, TEC:USERCAL:RESET

*SAV

Synopsis Save the instrument configuration

Syntax *SAV *bin*

Details Saves the current instrument configuration into one of four bins which can later be recalled using the *RCL command.

Argument	Value	Description
bin	1 to 4	Save bin

See Also *RCL

*SRE

Synopsis Set the Service Request Enable

Syntax *SRE *mask*

Details The *SRE command sets the Service Request Enable Register bits, which control the Master Status Summary bit in the Status Byte Register.

Argument	Bit	Value	Description
mask	0	1	TEC Event Summary
	1	2	TEC Condition Summary
	2	4	Laser Event Summary
	3	8	Laser Condition Summary
	4	16	Message Available
	5	32	Event Status Summary
	6	64	Request Service / Master Status Summary
	7	128	Error Message Available

See Also *SRE?

---

*SRE?

Synopsis Query the Service Request Enable

Syntax *SRE?

Details Returns the value of the Service Request Enable register. See the *SRE command for a definition of the response value.

See Also *SRE

---

*STB?

Synopsis Query the Status Byte Register

Syntax *STB?

Details Returns the value of the Status Byte Register.

Response	Bit	Value	Description
STB	0	1	TEC Event Summary
	1	2	TEC Condition Summary
	2	4	Laser Event Summary
	3	8	Laser Condition Summary
	4	16	Message Available
	5	32	Event Status Summary
	6	64	Request Service / Master Status Summary
	7	128	Error Message Available

See Also *SRE, *PRE

---

*WAI

Synopsis Wait for Operation Complete command

Syntax *WAI

Details The *WAI command will pause command processing until the Operation Complete flag is true.

BAUD

Synopsis Sets the baud rate on RS232 interfaces

Syntax BAUD *baudrate*

Details Changes the baud rate on RS232 interfaces. After sending the command, the baud rate will immediately be adjusted to the new speed, so if you are communicating over RS232, you must also change the PC-side baud rate to match.

Argument	Value	Description
baudrate	300	300 baud
	1200	1200 baud
	2400	2400 baud
	4800	4800 baud
	9600	9600 baud
	19200	19,200 baud
	38400	38,400 baud
	57600	57,600 baud
	115200	115,200 baud

BEEP

Synopsis Set the beep enable

Syntax BEEP [*enable*]

Details Causes the instrument to beep, or enables or disabled the beep sound for error messages and other events that generate and audible response. If *enable* is omitted, it is the equivalent of doing a 'BEEP 2'.

Argument	Value	Description
enable	0	Disable the beep sound
	1	Enable the beep sound
	2	Generate one beep

See Also BEEP?

BEEP?

Synopsis Query the beep enable

Syntax BEEP?

Details Returns the value of the Beep register.

Response	Value	Description
enable	0	Disable the beep sound
	1	Enable the beep sound

See Also BEEP

BRIGHT

Synopsis Set the display brightness

Syntax BRIGHT *brightness*

Details Sets the display brightness level, from 0 to 100 percent.

Argument	Value	Description
brightness	0 to 100	Brightness level of the display

On some displays, such as VFDs, there may only be 4 or 8 brightness levels, and the *brightness* parameter will be used to select an appropriate level.

See Also BRIGHT?

BRIGHT?

Synopsis Query the display brightness

Syntax BRIGHT?

Details Returns the value of the display brightness. See the BRIGHT command for more details.

See Also BRIGHT

CALdate?

Synopsis Query the calibration date

Syntax CALdate?

Details Returns the date string of the last calibration.

DELAY

Synopsis Causes a delay in command processing

Syntax DELAY *time*

Details Causes command processing to be delayed for the specified number of milliseconds.

Argument	Value	Description
time	1 to 30000	Delay, in milliseconds

EQUIPment?

Synopsis Query for installed equipment

Syntax EQUIPment?

Details The EQUIPment? query returns a comma-separated list of installed modules, which is model number from each module. For modular controllers, the first parameter is the model number of the chassis, followed by the model numbers of each module. For single channel instruments, it returns the model number of the instrument.

ERRors?

Synopsis Query for errors

Syntax ERRors?

Details Returns a comma–delimited list of error codes. If no error has occurred, a 0 is returned.

A typical response might look like:

```
201,124
```

See Also ERRSTR?

ERRSTR?

Synopsis Query for errors with string descriptions

Syntax ERRSTR?

Details Similar to the ERR? query, but a string description is included with the error code. A typical response might look like:

```
201,"Out of range",124,"Data mismatch"
```

See Also ERR?

HEXFLOAT

Synopsis Enables the hex float mode

Syntax HEXFLOAT *enable*

Details Enables transmission of hex floats from the instrument. See the section *Working with Radixes and Hex Floats* for more information on this mode.

Argument	Value	Description
enable	0	Hex float mode disabled
	1	Hex float mode enabled

See Also HEXFLOAT?

Support This function is only available in firmware version 2.0 and later.

HEXFLOAT?

Synopsis Query the state of the hex float mode

Syntax HEXFLOAT?

Details Returns the enable state of hex mode. See the HEXFLOAT command for more details.

Only supported on 6300 Series and 4200-DR Series controllers.

See Also HEXFLOAT

Support This function is only available in firmware version 2.0 and later.

LASer:AUX?

Synopsis Query the auxiliary voltage inputs

Syntax LASer:AUX? *index*

Details Returns the voltage (in volts) measured by the auxiliary voltage inputs. Only certain instruments (such as the LaserPak) support these inputs, see your instrument manual for details. For instruments that feature multiple auxiliary inputs, the *index* argument specifies which input to return.

Argument	Value	Description
index	0	Returns the first auxiliary input voltage
	1	Returns the second auxiliary input voltage
	Etc…	

If the auxiliary input is configured to be used as a temperature input, use the LAS:R? and LAS:T? queries to return the resistance or temperature measurement, respectively.

See Also LASer:R?, LASer:T?

Support Only supported on controllers with auxillary inputs, such as the 485 LaserPak. See your controller manual for more information.

LASer:CABLER

Synopsis Set cable resistance compensation

Syntax LASer:CABLER *resistance*

Details Set the cable resistance to adjust the voltage measurement to display the voltage at the laser, compensating for the voltage losses in the cable and connectors. See your instrument manual for additional information on using this feature.

Argument	Value	Description
resistance	0.0000 to 10.0000	Cable resistance, in ohms

See Also LASer:CABLER?

LASer:CABLER?

Synopsis Query the cable resistance compensation

Syntax LASer:CABLER?

Details Returns the value of the cable resistance compensation value. See the LASer:CABLER command for more details.

See Also LASer:CABLER

LASer:CALMD (CALPD)

Synopsis Set photodiode optical response

Syntax LASer:CALMD *PDresp*

Details Set the photodiode optical response value for converting photodiode current into optical power. This is the PD Response value from the instrument menu.

Argument	Value	Description
PDresp	0.0000 to 1000	Sensitivity in µA/mW

If *PDresp* is zero, then power mode will be unavailable, and the instrument will display photodiode current. If *PDresp* is non-zero, then power mode will be allowed, and the instrument will display optical power.

See Also LASer:CALMD?

LASer:CALMD? (CALPD?)

Synopsis Query the photodiode optical response

Syntax LASer:CALMD? (CALPD?)

Details Returns the value of the photodiode optical response. See the LASer:CALMD command for more details.

See Also LASer:CALMD

LASer:CAL:CANCEL

Synopsis Cancel calibration in progress

Syntax LASer:CAL:CANCEL

Details Cancels any calibration in progress.

LASer:CAL:LDX, LDX?, LVX, LVX?, MDX, MDX?

Synopsis Laser calibration functions

Details See the calibration section for details on how to use these commands.

LASer:COND?

Synopsis Query laser condition

Syntax LASer:COND?

Details Returns the laser condition register.

Response	Bit	Value	Description
conditions	0	1	Current limit
	1	2	Voltage limit
	2	4	Photodiode current limit
	3	8	Photodiode power limit
	4	16	Interlock disabled
	5	32	Unused
	6	64	Unused
	7	128	Laser open circuit
	8	256	Laser shorted
	9	512	Out of tolerance
	10	1024	Output on
	11	2048	Unused
	12	4096	Unused
	13	8192	R limit
	14	16384	T limit
	15	32768	Unused

See Also LASer:ENABLE:COND, *STB?

LASer:CONST

Synopsis Set the Sheinhart-Hart temperature conversion constants

Syntax LASer:CONST *A, B, C*

Details Sets the constants used in converting the resistance of auxiliary temperature inputs to °C using the Steinhart-Hart formula. By default, the thermistor constants are set to those for a BetaTHERM 10K3A1 thermistor.

Argument	Value	Description
A	± 9.9999	First Steinhart-Hart constant (x 10^{-3})
B	± 9.9999	Second Steinhart-Hart constant (x 10^{-4})
C	± 9.9999	Third Steinhart-Hart constant (x 10^{-7})

Some vendors may refer to A, B, and C as C1, C2, & C3.

See your user's manual for more information on using this function.

See Also LASer:CONST?

LASer:CONST?

Synopsis Query the Sheinhart-Hart temperature conversion constants

Syntax LASer:CONST?

Details Returns the sensor temperature conversion constants. See the LASer:CONST command for a complete definition of the *A*, *B*, and *C* response values.

See Also LASer:CONST

LASer:DC

Synopsis Set the duty cycle in QCW mode

Syntax LASer:DC *dutycycle*

Details This changes the duty cycle percentage when in QCW mode. A new frequency value will be computed based on the duty cycle and pulse width (the pulse width is not changed). If the resulting frequency is outside the allowable range, an E-201 error will be generated and the command ignored.

Argument	Description
dutycycle	Duty cycle, in percent

See Also LASer:DC?, LASer:F, LASer:PWF, LASer:PWP

Support Only supported on QCW-equipped controllers.

LASer:DC?

Synopsis Query the QCW duty cycle

Syntax LASer:DC?

Details Returns the value of the duty cycle. See LASer:DC for a definition of the *dutycycle* response value.

See Also LASer:DC

Support Only supported on QCW-equipped controllers.

LASer:DEC

Synopsis Decrement the laser set point

Syntax LASer:DEC *steps [, time]*

Details The LASer:DEC command uses the step size defined with the LASer:STEP command to decrement the laser set point. If the *time* parameter is omitted, then the set point is immediately decremented *steps* times the step size. If the *time* parameter is included, then the instrument will still decrement *steps* times the step size, but will pause at each step for *time* millisconds.

Argument	Value	Description
steps	1 to 65000	Number of steps to decrement
time	0 to 65000	Number of milliseconds to pause between each step

See Also LASer:INC, LASer:STEP

LASer:DELAYIN

Synopsis Set the pulse delay, in seconds, between the trigger input and output pulse

Syntax LASer:DELAYIN *delay*

Details Sets the delay from the rising edge of TRIGIN to the generation of the output pulse in QCW mode.

Argument	Value	Description
delay	0.000015 to 1	Delay, in seconds

See Also LASer:DELAYIN?, LASer:DELAYOUT

LASer:DELAYIN?

Synopsis Query the trigger input pulse delay

Syntax LASer:DELAYIN?

Details Returns the value of the trigger input delay. See LASer:DELAYIN for a definition of the *delay* response value.

See Also LASer:DELAYIN

Support Only supported on QCW-equipped controllers.

LASer:DELAYOUT

Synopsis Set the trigger output delay, in seconds, between the output pulse and the trigger output

Syntax LASer:DELAYOUT *delay*

Details Sets the delay from the rising edge of the pulse to the rising edge of TRIGOUT in QCW mode.

Argument	Value	Description
delay	0.000000 to 1	Delay, in seconds

See Also LASer:DELAYOUT?, LASer:DELAYIN

Support Only supported on QCW-equipped controllers.

LASer:DELAYOUT?

Synopsis Query the trigger output delay

Syntax LASer:DELAYOUT?

Details Returns the value of the trigger output delay. See LASer:DELAYOUT for a definition of the *delay* response value.

See Also LASer:DELAYOUT

Support Only supported on QCW-equipped controllers.

LASer:DISplay

Synopsis Set laser display enable

Syntax LASer:DISplay *enable*

Details The LASer:DISplay command can be used to completely lock out local operation of the instrument and display “Display Disabled” instead of the normal display.

Response	Value	Description
enable	0	Disables the display and front panel
	1	Enables the display and front panel

Once the display is disabled, the front panel is completely locked out. The only way to restore functionality to the front panel is to issue a “LASer:DISplay 1” or cycle power on the unit.

See Also LASer:DISplay?

LASer:DISplay?

Synopsis Query the display enable state

Syntax LASer:DISplay?

Details Returns the value of the laser display enable state. See LASer:DISplay for a definition of the *enable* response value.

See Also LASer:DISplay

LASer:ENABle:COND

Synopsis Set Laser Condition Enable register

Syntax LASer:ENABle:COND *conditions*

Details Enables reporting of selected conditions to the Status Byte Register. See the LASer:COND command for a definition of the *conditions* parameter.

See Also LASer:ENABLe:COND?, LASer:COND?

LASer:ENABle:COND?

Synopsis Query Laser Condition Enable register

Syntax LASer:ENABle:COND?

Details Returns the value of the Laser Condition Enable register. See the LASer:COND command for a definition of the *conditions* response.

See Also LASer:ENABLe:COND, LASer:COND?

LASer:ENABle:EVEnt

Synopsis Set Laser Event Enable register

Syntax LASer:ENABle:EVEnt *events*

Details Enables reporting of selected events to the Status Byte Register. See the LASer:EVEnt command for a definition of the *events* parameter.

See Also LASer:ENABle:EVEnt?, LASer:EVEnt?

LASer:ENABle:EVEnt?

Synopsis Query Laser Event Enable register

Syntax LASer:ENABle:EVEnt?

Details Returns the value of the Laser Event Enable register. See the LASer:EVEnt command for a definition of the *events* response.

See Also LASer:ENABLe:EVEnt, LASer:EVEnt?

LASer:ENABle:OUTOFF

Synopsis Set the Output Off Enable register

Syntax LASer:ENABle:OUTOFF *outoff*

Details The Output Off register controls what conditions will cause the laser output to be turned off. Some conditions are always enabled, as indicated below. The factory default conditions are shown in **bold**.

Argument	Bit	Value	Description
outoff	0	1	Current limit
	1	**2**	**Voltage limit (*always enabled*)**
	2	**4**	**Photodiode current limit**
	3	**8**	**Photodiode power limit**
	4	**16**	**Interlock disabled (*always enabled*)**
	5	32	Unused
	6	64	Unused
	7	**128**	**Laser open circuit (*always enabled*)**
	8	**256**	**Laser shorted (*always enabled)***
	9	512	Out of tolerance
	10	**1024**	**TEC off**
	11	**2048**	**TEC temperature limit**
	12	**4096**	**Hardware error (*always enabled)***
	13	8192	R limit
	14	16384	T limit
	15	**32768**	**Thermal limit exceeded (*always enabled*)**

The default value for this register is 40350.

See Also LASer:ENABle:OUTOFF?

LASer:ENABle:OUTOFF?

Synopsis Query the Output Off Enable register

Syntax LASer:ENABle:OUTOFF?

Details Returns the value of the Output Off register. See the LASer:ENABle:OUTOFF command for definition of *outoff* response value.

See Also LASer:ENABle:OUTOFF

LASer:EVEnt?

Synopsis Query the value of the laser event register

Syntax LASer:EVEnt?

Details Returns the laser event register.

Response	Bit	Value	Description
events	0	1	Current limit
	1	2	Voltage limit
	2	4	Photodiode current limit
	3	8	Photodiode power limit
	4	16	Interlock state changed
	5	32	Unused
	6	64	Unused
	7	128	Laser open circuit
	8	256	Laser short circuit
	9	512	Out of tolerance changed state
	10	1024	Output changed state
	11	2048	New data
	12	4096	Unused
	13	8192	R limit
	14	16384	T limit
	15	32768	Unused

After reading the event register, the event register is set to zero.

See Also LASer:ENABle:EVEnt

LASer:F

Synopsis Set the frequency of pulses in QCW mode

Syntax LASer:F *frequency*

Details Changes the frequency when in QCW mode. A new duty cycle value will be computed based on the frequency and pulse width (the pulse width is not changed). If the resulting duty cycle is outside the allowable range, an E-201 error will be generated and the command ignored.

Argument	Description
frequency	Frequency, in hertz

See Also LASer:F?

Support Only supported on QCW-equipped controllers.

LASer:F?

Synopsis Query the pulse frequency

Syntax LASer:F?

Details Returns the value of the frequency. See LASer:F for a definition of the *frequency* response value.

See Also LASer:F

Support Only supported on QCW-equipped controllers.

LASer:INC

Synopsis Increment the laser set point

Syntax LASer:INC *steps* [*, time*]

Details The LASer:INC command uses the step size defined with the LASer:STEP command to increment the laser set point. If the *time* parameter is omitted, then the set point is immediately incremented *steps* times the step size. If the *time* parameter is included, then the instrument will still increment *steps* times the step size, but will pause at each step for *time* milliseconds.

Argument	Value	Description
steps	1 to 65000	Number of steps to increment
time	0 to 65000	Number of milliseconds to pause between each step

See Also LASer:DEC, LASer:STEP

LASer:INTCONT

Synopsis Enables or disables the intermittent contact detection

Syntax LASer:INTCONT *enable*

Details The LASer:INTCONT turns the intermittent contact detection of the laser driver on or off. See the user's manual for more details.

Argument	Value	Description
enable	0	Turn intermittent contact detection off
	1	Turn intermittent contact detection on

See Also LASer:INTCONT?

Support Not all controllers support intermittent contact protection. See your controller's user manual for more details.

LASer:INTCONT?

Synopsis Query the state of the intermittent contact setting

Syntax LASer:INTCONT?

Details Returns the intermittent contact setting.

Response	Description
enable	The state of the intermittent contact setting

See Also LASer:INTCONT

Support Not all controllers support intermittent contact protection. See your controller's user manual for more details.

LASer:LDI (I)

Synopsis Set the laser current set point

Syntax LASer:LDI *setpoint*

Details The LASer:LDI sets the laser current set point. An error will be generated if the value of *setpoint* is greater than the current limit.

Argument	Value	Description
setpoint	0 to I_{lim}	Set the current set point in milliamps

See Also LASer:LDI?, LASer:LIMit:LDI, LASer:SET:LDI

LASer:LDI? (I?)

Synopsis Query the actual laser current

Syntax LASer:LDI?

Details Returns the actual (measured) laser current.

Response	Description
current	The actual (measured) current in milliamps

See Also LASer:LDI

LASer:LDIRES

Synopsis Set the laser current resolution

Syntax LASer:LDIRES *resoultion*

Details The LASer:LDIRES sets the laser current resolution for both the set point and measurement. An error will be generated if the value of *resolution* is not supported. See the LASer:LDIRESAVAIL? query to get a list of supported values.

Argument	Value	Description
resolution	*Model-specific*	Sets the resolution in milliamps

This function is only available in firmware version 2.0 and later.

See Also LASer:LDIRES?, LASer:LDIRESAVAIL?

Support This function is only available in firmware version 2.0 and later.

LASer:LDIRES?

Synopsis Query the laser current resolution value

Syntax LASer:LDIRES?

Details Returns the laser current resolution value.

Response	Description
resolution	The resolution value, in milliamps

See Also LASer:LDIRES, LASer:LDIRESAVAIL?

Support This function is only available in firmware version 2.0 and later.

LASer:LDIRESAVAIL?

Synopsis Query the list of available laser current resolution values

Syntax LASer:LDIRESAVAIL?

Details Returns a list of available current resolutions, which can be used with the LASer:LDIRES command to change the laser current set point and measurement resolution.

Response	Description
resolution	A comma separated list of available resolutions, in milliamps

See Also LASer:LDIRES, LASer:LDIRES?

Support This function is only available in firmware version 2.0 and later.

LASer:LDV

Synopsis Set the laser voltage set point

Syntax LASer:LDV *setpoint*

Details The LASer:LDV sets the laser voltage set point.

Argument	Value	Description
setpoint	0 to Vf_{limit}	Set the voltage set point in volts

See Also LASer:LIMit:LDV?, LASer:LDV?, LASer:SET:LDV?

LASer:LDV?

Synopsis Query the laser actual voltage

Syntax LASer:LDV?

Details Returns the actual laser voltage.

Response	Description
voltage	Actual laser voltage, in volts

See Also LASer:LIMit:LDV, LASer:LDV

LASer:LIMit:LDI (I)

Synopsis Set the laser current limit

Syntax LASer:LIMit:LDI *limit*

Details The LASer:LDI sets the laser current limit. If the laser current set point is greater than the value of *limit*, then laser current set point will be reduced to the value of *limit*.

Argument	Value	Description
limit	0 to I_{max}	Set the laser current limit in milliamps

See Also LASer:LDI, LASer:LIMit:LDI?

LASer:LIMit:LDI? (I?)

Synopsis Query the laser current limit

Syntax LASer:LIMit:LDI?

Details Returns the value of the laser current limit. See LASer:LIMit:LDI for a definition of the *limit* response value.

See Also LASer:LIMit:LDI

LASer:LIMit:LDV

Synopsis Set the laser voltage limit

Syntax LASer:LIMit:LDV *limit*

Details The LASer:LIMit:LDV sets the laser voltage limit. If the laser voltage set point is greater than the value of *limit*, then laser voltage set point will be reduced to the value of *limit*.

Argument	Value	Description
limit	0 to V_{max}	Set the laser voltage limit in volts

See Also LASer:LIMit:LDV?, LASer:LDV

LASer:LIMit:LDV?

Synopsis Query the laser voltage limit

Syntax LASer:LIMit:LDV?

Details Returns the value of the laser voltage limit. See LASer:LIMit:LDV for a definition of the *limit* response value.

See Also LASer:LIMit:LDV, LASer:LDV

LASer:LIMit:MDI (IPD)

Synopsis Set the photodiode current limit

Syntax LASer:LIMit:MDI *limit*

Details The LASer:LIMit:MDI sets the photodiode current limit. If the photodiode current set point is greater than the value of *limit*, then photodiode current set point will be reduced to the value of *limit*.

Argument	Value	Description
limit	0 to Im_{max}	Set the photodiode current limit in microamps

See Also LASer:LIMit:MDI?, LASer:MDI

LASer:LIMit:MDI? (IPD?)

Synopsis Query the photodiode current limit

Syntax LASer:LIMit:MDI?

Details Returns the value of the photodiode current limit. See LASer:LIMit:MDI for a definition of the *limit* response value.

See Also LASer:LIMit:MDI, LASer:MDI

LASer:LIMit:MDP (Ppd)

Synopsis Set the photodiode power limit

Syntax LASer:LIMit:MDP *limit*

Details The LASer:LIMit:MDP sets the photodiode power limit. If the photodiode power set point is greater than the value of *limit*, then photodiode power set point will be reduced to the value of *limit*.

Argument	Value	Description
limit	0 to P_{max}	Set the photodiode power limit in milliwatts

See Also LASer:LIMit:MDP?, LASer:MDP

LASer:LIMit:MDP? (Ppd?)

Synopsis Query the photodiode power limit

Syntax LASer:LIMit:MDP?

Details Returns the value of the photodiode power limit. See LASer:LIMit:MDP for a definition of the *limit* response value.

See Also LASer:LIMit:MDP, LASer:MDP

LASer:LIMit:RHIgh

Synopsis Set the high resistance limit

Syntax LASer:LIMit:RHIgh *limit*

Details The LASer:LIMit:RHI sets the upper resistance limit for auxiliary temperature sensor measurements. If the measured resistance from the temperature sensor exceeds the high limit, and the corresponding bit is enabled in the OUTOFF register, the laser output will be turned off.

Argument	Value	Description
limit	0 to 50000	Set the high resistance limit, in ohms

See Also LASer:ENABle:OUTOFF, LASer:LIMit:RHIgh?, LASer:RLOw

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:LIMit:RHIgh?

Synopsis Query the high resistance limit

Syntax LASer:LIMit:RHIgh?

Details Returns the value of the high resistance limit. See LASer:LIMit:RHIgh for a definition of the *limit* response value.

See Also LASer:LIMit:RHIgh

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:LIMit:RLOw

Synopsis Set the low resistance limit

Syntax LASer:LIMit:RLOw *limit*

Details The LASer:LIMit:RLO sets the lower resistance limit for auxiliary temperature sensor measurements. If the measured resistance from the temperature sensor exceeds the low limit, and the corresponding bit is enabled in the OUTOFF register, the laser output will be turned off.

Argument	Value	Description
limit	0 to 50000	Set the low resistance limit, in ohms

See Also LASer:ENABle:OUTOFF, LASer:LIMit:RLOw?, LASer:RLOw

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:LIMit:RLOw?

Synopsis Query the low resistance limit

Syntax LASer:LIMit:RLOw?

Details Returns the value of the low resistance limit. See LASer:LIMit:RLOw for a definition of the *limit* response value.

See Also LASer:LIMit:RLOw

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:LIMit:THIgh

Synopsis Set the high temperature limit

Syntax LASer:LIMit:THIgh *limit*

Details The LASer:LIMit:THI sets the upper temperature limit for auxiliary temperature sensor measurements. If the measured temperature from the temperature sensor exceeds the

high limit, and the corresponding bit is enabled in the OUTOFF register, the laser output will be turned off.

Argument	Value	Description
limit	0 to 50000	Set the high temperature limit, in °C

See Also LASer:ENABle:OUTOFF, LASer:LIMit:THIgh?, LASer:TLOw

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:LIMit:THIgh?

Synopsis Query the high temperature limit

Syntax LASer:LIMit:THIgh?

Details Returns the value of the high temperature limit. See LASer:LIMit:THIgh for a definition of the *limit* response value.

See Also LASer:LIMit:THIgh

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:LIMit:TLOw

Synopsis Set the low temperature limit

Syntax LASer:LIMit:TLOw *limit*

Details The LASer:LIMit:TLO sets the lower temperature limit for auxiliary temperature sensor measurements. If the measured temperature from the temperature sensor exceeds the low limit, and the corresponding bit is enabled in the OUTOFF register, the laser output will be turned off.

Argument	Value	Description
limit	0 to 50000	Set the low temperature limit, in °C

See Also LASer:ENABle:OUTOFF, LASer:LIMit:TLOw?, LASer:TLOw

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:LIMit:TLOw?

Synopsis Query the low temperature limit

Syntax LASer:LIMit:TLOw?

Details Returns the value of the low temperature limit. See LASer:LIMit:TLOw for a definition of the *limit* response value.

See Also LASer:LIMit:TLOw

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:MDI (IPD)

Synopsis Set the photodiode current set point

Syntax LASer:MDI *setpoint*

Details The LASer:MDI sets the photodiode current set point.

Argument	Value	Description
setpoint	0 to Im_{limit}	Set the photodiode current set point in microamps

See Also LASer:LIMit:MDI?, LASer:MDI?, LASer:SET:MDI?

LASer:MDI? (IPD?)

Synopsis Query the actual photodiode current

Syntax LASer:MDI?

Details Returns the actual photodiode current.

Response	Description
PDcurrent	Actual photodiode current, in microamps

See Also LASer:LIMit:MDI, LASer:MDI

LASer:MDP (Ppd)

Synopsis Set the photodiode power set point

Syntax LASer:MDP *setpoint*

Details The LASer:MDP sets the photodiode power set point.

Argument	Value	Description
setpoint	0 to Po_{limit}	Set the photodiode power set point in milliwatts

See Also LASer:LIMit:MDP?, LASer:MDP?, LASer:SET:MDP?

LASer:MDP? (Ppd?)

Synopsis Query the actual photodiode power

Syntax LASer:MDP?

Details Returns the actual photodiode power.

Response	Description
PDpower	Actual photodiode power, in milliwatts

See Also LASer:LIMit:MDP, LASer:MDP

LASer:MODE?

Synopsis Query operational mode

Syntax LASer:MODE?

Details Returns the control mode of the laser driver.

Response	Value	Description
mode	ILBW	Laser current control (Io/ACC) mode, low bandwidth
	IHBW	Laser current control (Io HiBW) mode, high bandwidth
	PULSE	Laser current control (Io Pulse) mode, QCW internal trigger
	TRIG	Laser current control (Io Ext Trig) mode, QCW external trigger
	BURST	Laser current control (Io Burst) mode, QCW burst
	MDI	Photodiode current control (Im/AMC) mode
	MDP	Photodiode power control (Po/APC) mode
	LDV	Laser voltage control (Vf/AVC) mode

See Also LASer:MODE:ILBW, LASer:MODE:IHBW, LASer:MODE:PULSE, LASer:MODE:TRIG, LASer:MODE:BURST, LASer:MODE:MDI, LASer:MODE:MDP; LAS:MODE:LDV

LASer:MODE:BURST

Synopsis Set operational mode to laser current control, QCW burst.

Syntax LASer:MODE:BURST

Details Switches the Laser driver to laser current control mode, QCW burst. Pulses are triggered with a LASer:TRIGGER command or via the external trigger. The number of pulses is controlled by the LASer:QCWCOUNT command. If the mode is being changed and the laser output is on, the laser output will be turned off and an error generated.

See Also LASer:MODE?, LASer:QCWCOUNT, LASer:TRIGGER

Support Only supported on QCW-equipped controllers.

LASer:MODE:ICW (CW)

Synopsis Set operational mode to laser current control, continuous wave

Syntax LASer:MODE:ICW

Details This command is identical to LASer:MODE:ILBW, and is included for compatibility reasons. If a LASer:MODE? query is done after this command is issued, “ILBW” will be returned.

See Also LASer:MODE:ILBW

LASer:MODE:ILBW (I)

Synopsis Set operational mode to laser current control, low bandwidth

Syntax LASer:MODE:ILBW

Details Switches the Laser driver to laser current control mode, low bandwidth. If the mode is being changed and the laser output is on, the laser output will be turned off and an error generated.

See Also LASer:MODE?

LASer:MODE:IHBW

Synopsis Set operational mode to laser current control, high bandwidth

Syntax LASer:MODE:IHBW

Details Switches the Laser driver to laser current control mode, high bandwidth. If the mode is being changed and the laser output is on, the laser output will be turned off and an error generated.

See Also LASer:MODE?

LASer:MODE:LDV

Synopsis Set operational mode to laser voltage control

Syntax LASer:MODE:LDV

Details Switches the Laser driver to laser voltage control mode. If the mode is being changed and the laser output is on, the laser output will be turned off and an error generated.

See Also LASer:MODE?

LASer:MODE:MDI (IPD)

Synopsis Set operational mode to photodiode current control

Syntax LASer:MODE:MDI

Details Switches the Laser driver to photodiode current control mode. If the mode is being changed and the laser output is on, the laser output will be turned off and an error generated.

See Also LASer:MODE?

LASer:MODE:MDP (Ppd)

Synopsis Set operational mode to photodiode power control

Syntax LASer:MODE:MDP

Details Switches the Laser driver to photodiode power control mode. If the mode is being changed and the laser output is on, the laser output will be turned off and an error generated.

See Also LASer:MODE?

LASer:MODE:PULSE

Synopsis Set operational mode to laser current control, QCW mode, internal trigger

Syntax LASer:MODE:PULSE

Details Switches the Laser driver to laser current control mode, QCW. Pulses are internally generated using the pulse width, duty cycle, and frequency settings. If the mode is being changed and the laser output is on, the laser output will be turned off and an error generated.

See Also LASer:MODE?

Support Only supported on QCW-equipped controllers.

LASer:MODE:TRIG

Synopsis Set operational mode to laser current control, QCW mode, external trigger

Syntax LASer:MODE:TRIG

Details Switches the Laser driver to laser current control mode, QCW. Pulses are externally triggered with the TRIGIN signal. Each rising edge of TRIG in generates one pulse. Pulse width is determined by the pulse width setting. Duty cycle and frequency are ignored. If the mode is being changed and the laser output is on, the laser output will be turned off and an error generated.

See Also LASer:MODE?

Support Only supported on QCW-equipped controllers.

LASer:OUTput

Synopsis Set the laser output state

Syntax LASer:OUTput *state*

Details Turns the laser output on or off.

Argument	Value	Description
state	0	Turn the output off
	1	Turn the output on

See Also LASer:OUTput?

LASer:OUTput?

Synopsis Query the laser output state

Syntax LASer:OUTput?

Details Returns the value of the laser current limit. See LASer:OUT for a definition of the *state* response value.

See Also LASer:OUTput

LASer:PDBias

Synopsis Set the photodiode bias voltage set point

Syntax LASer:PDBias *voltage*

Details Sets the photodiode bias voltage set point.

Argument	Value	Description
voltage	0 to 5	Negative voltage bias set point, in volts

See Also LASer:PDBias?

LASer:PDBias?

Synopsis Query the photodiode bias voltage set point

Syntax LASer:PDBias?

Details Returns the value of the photodiode bias voltage set point. See LASer:PDBias for a definition of the *voltage* response value.

See Also LASer:PDBias

LASer:PW?

Synopsis Query the pulse width

Syntax LASer:PW?

Details Returns the pulse width, in milliseconds. See LASer:PWF and LASer:PWP for more information on setting the pulse width.

See Also LASer:PWF, LASer:PWP

Support Only supported on QCW-equipped controllers.

LASer:PWF

Synopsis Set the pulse width while holding the frequency constant

Syntax LASer:PWF *pulsewidth*

Details Changes the pulse width when in QCW mode. A new duty cycle value will be computed based on the frequency and pulse width. If the resulting duty cycle is outside the allowable range, an E-201 error will be generated and the command ignored.

Argument	Description
pulsewidth	Pulse width, in milliseconds

See Also LASer:PW?, LASer:PWP, LASer:QCWHOLD

Support Only supported on QCW-equipped controllers.

LASer:PWP

Synopsis Set the pulse width while holding the duty cycle constant

Syntax LASer:PWP *pulsewidth*

Details Changes the pulse width when in QCW mode. A new frequency value will be computed based on the duty cycle and pulse width. If the resulting frequency is outside the allowable range, an E-201 error will be generated and the command ignored.

Argument	Description
pulsewidth	Pulse width, in milliseconds

See Also LASer:PW?, LASer:PWF, LASer:QCWHOLD

Support Only supported on QCW-equipped controllers.

LASer:QCWHOLD

Synopsis Set the QCW (pulse) hold setting for pulse width adjustments in the user interface

Syntax LASer:QCWHOLD *hold*

Details Sets which value to hold constant (frequency or duty cycle) when making pulse width adjustments in the user interface.

This command has no effect on the LASer:PWF and LASer:PWP commands, as they explicitly define which will be held constant. It only affects the pulse width adjustments done through the front panel.

Argument	Value	Description
hold	0	Hold frequency constant
	1	Hold duty cycle constant

See Also LASer:QCWHOLD?

Support Only supported on QCW-equipped controllers.

LASer: QCWHOLD?

Synopsis Queries the QCW (pulse) hold setting for pulse width adjustments in the user interface

Syntax LASer:QCWHOLD?

Details Returns the value of the hold constant. See LASer:QCWHOLD for a definition of the *hold* response value.

See Also LASer:QCWHOLD

Support Only supported on QCW-equipped controllers.

LASer:QCWCOUNT

Synopsis Set the QCW burst count

Syntax LASer:QCWCOUNT *count*

Details Sets how many pulses will be generated for each burst when operating in IO (Burst) mode.

Argument	Value	Description
count	1 – 60,000	Number of pulses per burst

See Also LASer:QCWCOUNT?

Support Only supported on QCW-equipped controllers.

LASer: QCWCOUNT?

Synopsis Queries the number of pulses generated for each burst when operating in Io (Burst) mode.

Syntax LASer:QCWCOUNT?

Details Returns the pulse count.. See LASer:QCWCOUNT for a definition of the *count* response value.

See Also LASer:QCWCOUNT

Support Only supported on QCW-equipped controllers.

LASer:R?

Synopsis Queries the resistance measurement of the auxiliary temperature sensor

Syntax LASer:R?

Details Returns the resistance measurement, in ohms, from the auxiliary temperature sensor input.

See Also LASer:T?

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:RANGE

Synopsis Set the output current range

Syntax LASer:RANGE *range*

Details For instruments that support dual range operation, this command sets the low or high range.

Argument	Value	Description
range	0	Low range
	1	High range

See Also LASer:RANGE?

Support Not supported on single range instruments.

LASer: RANGE?

Synopsis Queries the laser current range.

Syntax LASer:RANGE?

Details Returns the current range. See LASer:RANGE for a definition of the *range* response value.

See Also LASer:RANGE

Support Not supported on single range instruments.

LASer:SET:LDI? (I?)

Synopsis Query the laser current set point

Syntax LASer:SET:LDI?

Details Returns the value of the laser current set point. See LASer:LDI for a definition of the *setpoint* response value.

See Also LASer:LDI

LASer:SET:LDV?

Synopsis Query the laser voltage set point

Syntax LASer:SET:LDV?

Details Returns the value of the laser voltage set point. See LASer:LDV for a definition of the *setpoint* response value.

See Also LASer:LDV

LASer:SET:MDI? (IPD?)

Synopsis Query the photodiode current set point

Syntax LASer:SET:MDI? (IPD?)

Details Returns the value of the photodiode current set point. See LASer:MDI for a definition of the *setpoint* response value.

See Also LASer:MDI

LASer:SET:MDP? (Ppd?)

Synopsis Query the photodiode power set point

Syntax LASer:SET:MDP? (Ppd?)

Details Returns the value of the photodiode power set point. See LASer:MDP for a definition of the *setpoint* response value.

See Also LASer:MDP

LASer:STB?

Synopsis Query the laser status byte

Syntax LASer:STB?

Details Returns a summary of the enabled conditions within the laser condition and event registers. These bits mirror the bits in the Status Byte Register.

Argument	Bit	Value	Description
status	2	4	Event status register summary
	3	8	Condition status register summary

The values are additive, so a return value of 0, 4, 8, or 12 is possible.

See Also *STB?, LASer:COND?, LASer:ENAB:COND, LASer:ENABle:EVENT, LASer:EVEnt?

LASer:STEP

Synopsis Set laser step size

Syntax LASer:STEP *size*

Details The command sets the laser step size used by the LASer:INC or LASer:DEC commands.

Argument	Value	Description
size	1 to 65000	Step size

A step of 1 equates to 0.01mA, 0.01mW, or 1µA, depending on the control mode.

See Also LASer:DEC, LASer:INC, LASer:STEP?

LASer:STEP?

Synopsis Query the laser step size

Syntax LASer:STEP?

Details Returns the value of the laser step size. See LASer:STEP for a definition of the *size* response value.

See Also LASer:STEP

LASer:T?

Synopsis Queries the converted temperature measurement of the auxiliary temperature sensor

Syntax LASer:T?

Details Returns the converted temperature measurement, in °C, of the auxiliary temperature sensor input. The conversion from resistance to temperature is done using the Steinhard-Hart formula and the constants set by the LASer:CONST command.

See Also LASer:CONST, LASer:R?

Support This function is only supported for controllers with auxiliary temperature inputs. See your controller's manual for more information.

LASer:TOLerance

Synopsis Set the laser tolerance criteria

Syntax LASer:TOLerance *tolerance, time*

Details The LASer:TOLerance command allows control over when the output of the laser driver is considered in tolerance (or stable), in order to satisfy the tolerance condition of the operation complete definition. When used in conjunction with the *WAI command, it can control when the next command is processed, delaying processing until the output stabilizes at its set point.

Argument	Value	Description
tolerance	0 to I_{max}	Current tolerance, in milliamps
time	0.1 to 50	Time window in seconds

To be considered in tolerance, the measured current must be within the set point plus or minus the *tolerance* value (the tolerance window) for *time* seconds. Any time it leaves the tolerance window, the timer will reset to zero and begin counting the next time it enters the tolerance window.

In photodiode current mode, the *tolerance* is fixed at 50µA. In photodiode power mode, *tolerance* is fixed at 50mW. In voltage control mode, *tolerance* is fixed at 50mV.

See Also LASer:TOLerance?

LASer:TOLerance?

Synopsis Query the laser tolerance criteria

Syntax LASer:TOLerance?

Details Returns the value of the laser tolerance criteria. See LASer:TOLerance for a definition of the *tolerance* and *time* response values.

See Also LASer:TOLerance

LASer:TRIGger

Synopsis Generates a single trigger

Syntax LASer:TRIGger

Details The LASer:TRIGger command is used to generate a trigger into the QCW system, and acts exactly like a single rising edge on the Trigger Input BNC. See the manual section on QCW operation for more information on triggering.

Support Only supported on QCW-equipped controllers.

LASer:USERCAL:EDIT

Synopsis Enable or disabled user calibration editing

Syntax LASer:USERCAL:EDIT *enable*

Details Sets the edit enable state for user calibration. A LASer:USERCAL:PUT command will fail until the editing is enabled with this command. The edit state will automatically be set to false after a *RST command or power cycle.

Argument	Value	Description
enable	0	User calibration editing disabled
	1	User calibration editing enabled

See Also LASer:USERCAL:EDIT?, LASer:USERCAL:PUT

Support This function is only available in firmware version 2.0 and later.

LASer:USERCAL:EDIT?

Synopsis Query the state of the user calibration edit enable flag

Syntax LASer:USERCAL:EDIT?

Details Returns 0 if user calibration editing is disabled, and 1 if user calibration editing is enabled.

See Also LASer:USERCAL:EDIT

Support This function is only available in firmware version 2.0 and later.

LASer:USERCAL:GET?

Synopsis Query a laser USERCAL setting

Syntax LASer:USERCAL:GET? *index*

Details Returns the slope and offset compensation values for a specific user calibration *index*. See LASer:USERCAL:PUT for a definition of the *index* argument and *slope* and *offset* response values.

See Also LASer:USERCAL:PUT

Support This function is only available in firmware version 2.0 and later.

LASer:USERCAL:GETALL?

Synopsis Query all laser USERCAL settings

Syntax LASer:USERCAL:GETALL? *addterm*

Details Returns the slope and offset compensation values for all user calibration indexes. If *addterm* is non-zero, command terminator (CR, LF, or CR/LF) will be sent after each index. See LASer:USERCAL:PUT for a definition of the *index* argument and *slope* and *offset* response values.

See Also LASer:USERCAL:PUT

Support This function is only available in firmware version 2.0 and later.

LASer:USERCAL:PUT

Synopsis Sets a USERCAL value

Syntax LASer:USERCAL:PUT *index, slope, offset*

Details The command sets the user calibration setting for a specific *index,* allowing for user compensation of measurements or set points. The default value for all slopes is 1, and the default value for all offsets is 0.

Compensation is applied according to the following formula:

*compensated = slope * uncompensated + offset*

Argument	Value	Description
index	1	Io set point, low range
	2	Io set point, high range
	3	Im set point
	4	Vf set point
	5	Vf set point, remote sense
	6	Io measurement, low range
	7	Io measurement, high range
	8	Im measurement
	9	Vf measurement
	10	Vf measurement, remote sense
	11	Io measurement, low range, QCW mode
	12	Io measurement, high range, QCW mode
	13	Im measurement, QCW mode
	14	Vf measurement, QCW mode
	15	Vf measurement, remote sense, QCW mode
	16	Auxiliary 1 voltage measurement
	17	Auxiliary 2 voltage measurement
	18	Auxiliary 1 resistance measurement
	19	Auxiliary 2 resistance measurement
slope	*0.9 to 1.1*	Slope compensation
offset	*±5% of range*	Offset compensation

LASer:USERCAL:PUT is only supported on certain instruments. Not all indexes are supported in every instrument. See your user's manual for details on what measurements are supported.

You must enable editing of user calibration values with the LASer:USERCAL:EDIT command.

See Also LASer:USERCAL:EDIT, LASer:USERCAL:GET?

Support This function is only available in firmware version 2.0 and later.

LASer:USERCAL:RESET

Synopsis Resets all laser user calibration settings to factory defaults

Syntax LASer:USERCAL:RESET

Details Resets all laser user calibration slopes to 1 and all offsets to 0.

See Also LASer:USERCAL:EDIT

Support This function is only available in firmware version 2.0 and later.

LASer:VSENSE

Synopsis Select local or remote voltage sense

Syntax LASer:VSENSE *select*

Details For instruments that support selectable local/remote voltage sense, this command selects local or remote sense.

Argument	Value	Description
select	0	Local voltage sense
	1	Remote voltage sense

See Also LASer:VSENSE?

Support Only supported on instrument equipped with 4-wire voltage sense capability. See your controller's manual for more details.

LASer: VSENSE?

Synopsis Queries the voltage sense selection.

Syntax LASer:VSENSE?

Details For instruments that support selectable local/remote voltage sense, this command returns the *select* value. See the LASer:VSENSE command for more information.

See Also LASer:VSENSE

Support Only supported on instrument equipped with 4-wire voltage sense capability. See your controller's manual for more details.

LOCAL

Synopsis Returns instrument to local mode

Syntax LOCAL

Details After issuing the LOCAL command, the remote light will go out, and front panel controls will be enabled.

MESsage

Synopsis Set the message buffer

Syntax MESsage *string*

Details Sets the internal message buffer to the value of *string*, up to a maximum of 16 characters.

See Also MESsage?

MESsage?

Synopsis Query the message buffer

Syntax MESsage?

Details Returns the value of the message buffer.

See Also MESsage

ONDELAY

Synopsis Set the laser output on delay

Syntax ONDELAY *time*

Details The ONDELAY command controls how long the laser driver will delay between the time the user or command turns on the laser on LED and when the output is actually turned on.

Argument	Value	Description
time	0 to 30000	On delay, in milliseconds

Setting the ONDELAY value to 0 disables the delay feature.

See Also ONDELAY?

ONDELAY?

Synopsis Query the laser output on delay

Syntax ONDELAY?

Details Returns the value of the laser output on delay. See the ONDELAY command for a complete definition of possible return values.

See Also ONDELAY

RADix

Synopsis Set the radix (number base)

Syntax RADix *base*

Details By default, the instrument is set to decimal number base. Changing to an alternate number base will cause queries for integer values to be returned in the specified number base.

Argument	Value	Description
base	BIN	Binary format (base 2)
	OCT	Octal format (base 8)
	DEC	Decimal format (base 10)
	HEX	Hexadecimal format (base 16)

See the section *Working with Radixes and Hex Floats* for more information on using this command.

See Also RADix?

RADix?

Synopsis Query the radix (number base)

Syntax RADix?

Details Returns the current number base. See the RADix command for a complete definition of possible return values.

See Also RADix

REMERR

Synopsis Set display of errors while in remote mode

Syntax REMERR *enable*

Details This command controls if the instrument will display errors while in remote mode. If set to zero, then errors will not be displayed. If set to one, errors will be displayed. Errors will always accumulate in the error queue.

Argument	Value	Description
enable	0	Do not display errors in remote mode
	1	Display errors in remote mode

See Also REMERR?, ERR?, ERRSTR?

REMERR?

Synopsis Query the display of errors while in remote mode

Syntax REMERR?

Details Returns the current REMERR setting. See the REMERR command for a complete definition of possible return values.

See Also REMERR

REMSET

Synopsis Enables the changing of the set point and on/off control from the front panel while in remote mode

Syntax REMERR *enable*

Details This command enables the changing of the set point and on/off control from the front panel while in remote mode. By default, when in remote mode, the set point cannot be changed and output cannot be turned on or off, as most programs do not react well to the set point or on/off state being changed asynchronously from the program operation. However, it can be quite useful to be able to continue to adjust the instrument even when it is under remote control, and this command enables or disabled this capability.

Alternatively, if your program no longer needs to remotely control the instrument, you can use the LOCAL command to return the instrument to local control.

Argument	Value	Description
enable	0	Prevent set point and on/off change while in remote mode
	1	Enable set point and on/off change while in remote mode

See Also REMSET?, LOCAL

REMSET?

Synopsis Query the state of the remote set mode

Syntax REMSET?

Details Returns the current REMSET setting. See the REMSET command for more information.

See Also REMSET

SCRIPT:GET?

Synopsis Retrieve a script

Syntax SCRIPT:GET? *index*

Details Returns the script stored in position *index*. See the *Using Scripts* section above for more information.

See Also SCRIPT:PUT

Support This function is only available in firmware version 2.0 and later.

SCRIPT:GO

Synopsis Remotely executes a script

Syntax SCRIPT:GO *index*

Details Executes the script stored at position *index.* See the *Using Scripts* section above for more information.

See Also SCRIPT:PUT

Support This function is only available in firmware version 2.0 and later.

SCRIPT:PUT

Synopsis Set a script

Syntax SCRIPT:PUT *index, script*

Details Stores a script for execution by a function key, or with the SCRIPT:GO command. See the *Using Scripts* section above for more information.

Argument	Description
index	Script index, 1 to 4
script	Script, maximum 200 characters.

See Also SCRIPT:GET?, SCRIPT:GO

Support This function is only available in firmware version 2.0 and later.

SN?

Synopsis Query the serial number of the instrument

Syntax SN?

Details Returns the serial number of the instrument. This is the same information that is part of the *IDN? query.

See Also *IDN?

TEC:ACTIVESENsor

Synopsis Selects the active sensor

Syntax TEC:ACTIVESENsor *sensor index*

Details For controllers that support multiple primary sensors, this command selects which primary sensor will be used for feedback in the temperature control loop. The primary sensor type must be set to a sensor type other than disabled prior to selecting it.

Argument	Description
sensor index	Sensor index of the primary sensor to use for the control loop.

Only primary sensors can be selected. Only supported on instruments that feature multiple primary sensors.

See Also TEC:AUTOTUNE?

TEC:ACTIVESENsor?

Synopsis Query the active sensor

Syntax TEC:ACTIVESENsor?

Details Returns the active sensor. See the TEC:ACTIVESENsor for a definition of the *sensor index* reply.

See Also TEC:ACTIVESENsor

TEC:ANALOG:MODE

Synopsis Enable or disable the analog set point mode

Syntax TEC:ANALOG:MODE *enable*

Details Enables or disables the analog set point mode.

Argument	Description
enable	1 to enable, 0 to disable

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:AUTOTUNE?

TEC:ANALOG:MODE?

Synopsis Query the analog set point mode

Syntax TEC:ANALOG:MODE?

Details Returns the enable state of the analog set point mode.

Response	Description
enable	1 if enabled, 0 if disabled

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:ANALOG:MODE

TEC:ANALOG:OUT

Synopsis Sets analog output function

Syntax TEC:ANALOG:OUT *function [, parameter]*

Details Sets the analog output function that controls the voltage of the analog output. The *parameter* argument is only used on functions 1, 2, and 3.

Argument		Description
function	0	Disabled (output zero volts)
	1	Direct set of voltage
	2	Temperature error
	3	Temperature
	4	Current
parameter	-5.00 to +5.00	When function=1, directly controls the output voltage
	0 to 2	When function=2, selects error transfer function
	0 to 2	When function=3, selects temperature transfer function

See the instrument's user's manual for more information on the use of the analog output interface. Only supported on instruments that feature an analog output function.

See Also TEC:ANALOG:RES?

TEC: ANALOG:OUT?

Synopsis Query the analog output function

Syntax TEC:ANALOG:OUT?

Details Returns the enable state of the analog output function. See TEC:ANALOG:OUT for a definition of the *function* and *parameter* returned by the query.

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:ANALOG:OUT

TEC:ANALOG:RES

Synopsis Sets the resolution of the analog temperature set point

Syntax TEC:ANALOG:RES *resolution*

Details Sets the resolution of the analog temperature set point.

Argument		Description
resolution	0	Temperature set will be rounded to nearest 1°C
	1	Temperature set will be rounded to nearest 0.1°C
	2	Temperature set will be rounded to nearest 0.01°C

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:ANALOG:RES?

TEC: ANALOG:RES?

Synopsis Query the resolution of the analog temperature set point

Syntax TEC:ANALOG:MODE?

Details Returns the enable state of the analog set point mode.

Response		Description
resolution	0	Temperature set will be rounded to nearest 1°C
	1	Temperature set will be rounded to nearest 0.1°C
	2	Temperature set will be rounded to nearest 0.01°C

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:ANALOG:RES

TEC:ANALOG:THIGH

Synopsis Sets the upper temperature used in scaling the analog temperature set point

Syntax TEC:ANALOG:THIGH *temperature*

Details Sets the upper temperature used in scaling the analog temperature set point.

Argument	Description
temperature	Set the $T_{ANALOG-HIGH}$ used in the calculation of the analog temperature set point.

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:ANALOG:THIGH?

TEC: ANALOG:THIGH?

Synopsis Query the upper temperature used in scaling the analog temperature set point

Syntax TEC:ANALOG:THIGH?

Details Returns the $T_{ANALOG-HIGH}$ used in the calculation of the analog temperature set point.

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:ANALOG:THIGH

TEC:ANALOG:TLOW

Synopsis Sets the lower temperature used in scaling the analog temperature set point

Syntax TEC:ANALOG:TLOW *temperature*

Details Sets the lower temperature used in scaling the analog temperature set point.

Argument	Description
temperature	Set the $T_{ANALOG-LOW}$ used in the calculation of the analog temperature set point.

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:ANALOG:TLOW?

TEC: ANALOG:TLOW?

Synopsis Query the lower temperature used in scaling the analog temperature set point

Syntax TEC:ANALOG:TLOW?

Details Returns the $T_{ANALOG-LOW}$ used in the calculation of the analog temperature set point.

See the instrument's user's manual for more information on the use of the analog interface. Only supported on instruments that feature an analog input function.

See Also TEC:ANALOG:TLOW

TEC:AUTOTUNE

Synopsis Start the AutoTune process

Syntax TEC:AUTOTUNE *temperature*

Details The TEC:AUTOTUNE command is used to start the AutoTune process, using the *temperature* parameter as the AutoTune point. The current and temperature limits should be properly setup prior to starting AutoTune.

Argument	Description
temperature	AutoTune test point, in °C

See the AutoTune section in the user's manual for further information.

See Also TEC:AUTOTUNE?

TEC:AUTOTUNE?

Synopsis Query the AutoTune result

Syntax TEC:AUTOTUNE?

Details Returns the result of the last AutoTune process.

Response	Description
0	No AutoTune has been performed since last power-up
1	AutoTune in process
2	Last AutoTune failed
3	Last AutoTune successful

The TEC:AUTOTUNESTATE? provides additional details during the AutoTune process.

See Also TEC:AUTOTUNE, TEC:AUTOTUNESTATE?

TEC:AUTOTUNESTATE?

Synopsis Query the AutoTune result

Syntax TEC:AUTOTUNESTATE?

Details Returns the progress of the AutoTune process.

Response	Description
0	No AutoTune in process
100	AutoTune initializing
200	AutoTune in P ramp phase
300	AutoTune in P stabilize phase
400	AutoTune in I ramp phase
500	AutoTune Complete

See Also TEC:AUTOTUNE

TEC:CABLER

Synopsis Set the cable resistance

Syntax TEC:CABLER *resistance*

Details The TEC:CABLER command can be used to set the cable resistance, which is then used to remove voltage drops from the TEC voltage measurement.

Argument	Description
resistance	Resistance of the cable, in ohms.

See the user's manual for additional information on using this setting.

See Also TEC:CABLER?, TEC:VTE?

TEC:CABLER?

Synopsis Query the cable resistance value

Syntax TEC:CABLER?

Details Returns the value of the cable resistance value. See TEC:CABLER for a definition of the *resistance* response value.

See Also TEC:CABLER

TEC:CABLETYPE?

Synopsis Returns the cable type (high or low current)

Syntax TEC:CABLETYPE?

Details Returns the current rating for the cable plugged into the instrument.

Response	Description
0	8A cable
1	10A cable

TEC:COND?

Synopsis Query TEC condition

Syntax TEC:COND?

Details Returns the TEC condition register.

Response	Bit	Value	Description
conditions	0	1	Current limit
	1	2	Voltage limit
	2	4	Sensor limit
	3	8	Temperature high limit
	4	16	Temperature low limit
	5	32	Sensor shorted
	6	64	Sensor open
	7	128	TEC open circuit
	8	256	Unused
	9	512	Out of tolerance
	10	1024	Output on
	11	2048	Unused
	12	4096	Unused
	13	8192	Unused
	14	16384	Unused
	15	32768	Unused

See Also TEC:ENABle:COND, *STB?

TEC:CONST

Synopsis Set sensor temperature conversion constants for the active sensor

Syntax TEC:CONST *A, B [, C [, R0]]*

Details The TEC:CONST command sets the sensor constants for conversion of the sensor value to temperature for the active sensor. The number of parameters are dependent on the sensor type.

For the thermistor sensors, A, B, and C are used as constants for the Steinhart-Hart equation for conversion of resistance to temperature. By default, the thermistor constants are set to those for a BetaTHERM 10K3A1 thermistor.

For LM335 and AD590 sensors, A is used as a slope correction (M) term and B is an offset (B) term. By default, A is set to one and B is set to zero.

For RTD sensors, A, B, C, and R0 are used as constants for the RTD to temperature equation. By default, the RTD constants are set to the standard 100Ω Laboratory values.

Argument	Value	Description
For Thermistors:		
A	± 9.9999	First Steinhart-Hart constant (x 10^{-3})
B	± 9.9999	Second Steinhart-Hart constant (x 10^{-4})
C	± 9.9999	Third Steinhart-Hart constant (x 10^{-7})
For LM335:		
A	± 9.9999	Slope term
B	± 99.9999	Offset term, in °C
For AD590:		
A	± 9.9999	Slope term
B	± 99.9999	Offset term, in °C
For RTD:		
A	± 9.9999	First RTD constant (x 10^{-3})
B	± 9.9999	Second RTD constant (x $10^{-6)}$
C	± 9.9999	Third RTD constant (x 10^{-12})
R0	*10 to 220*	Nominal resistance at 0°C (Ω)

Some vendors may refer to A, B, and C as C1, C2, & C3.

For additional information, see the sensor sections in the user's manual.

See Also TEC:CONST?

TEC:CONST?

Synopsis Query sensor temperature conversion constants for the active sensor

Syntax TEC:CONST?

Details Returns the sensor temperature conversion constants. See the TEC:CONST command for a complete definition of the *A*, *B*, *C*, and *R0* response values.

See Also TEC:CONST

TEC:CONSTIDX

Synopsis Set sensor temperature conversion constants for a specific sensor index and type

Syntax TEC:CONSTIDX *sensor class, sensor type, A, B [, C [, R0]]*

Details The TEC:CONSTIDX command works identically to the TEC:CONST command, except that the sensor index and sensor type is explicitly set by the command arguments. The number of additional parameters is dependent on the sensor type.

See TEC:CONST for details on the sensor parameters (A, B, C, and R0). *Sensor index* and *sensor type* are defined below:

Argument	Value	Description
sensor class	1	Primary
	2	*Auxillary*
sensor type	0	Disabled
	1	100uA Thermistor
	2	10uA Thermistor
	3	LM335
	4	AD590
	5	RTD
	6	RTD (4-wire sense)
	7	1mA Thermistor

See Also TEC:CONST, TEC:CONSTIDX?

TEC:CONSTIDX?

Synopsis Query sensor temperature conversion constants for a specific sensor index and type

Syntax TEC:CONSTIDX? *sensor index, sensor type*

Details Complementary function to TEC:CONSTIDX, and returns the sensor temperature conversion constants for a specific sensor index and sensor type. See the TEC:CONSTIDX command for a complete definition of the *sensor index* and *sensor type* arguments.

See Also TEC:CONSTIDX

TEC:DEC

Synopsis Decrement the TEC set point

Syntax TEC:DEC *steps*

Details The TEC:DEC command uses the step size defined with the TEC:STEP command to decrement the TEC set point. The set point is decremented *steps* times the step size.

Argument	Value	Description
steps	1 to 65000	Number of steps to decrement

See Also TEC:INC, TEC:STEP

TEC:DIO:IN?

Synopsis Query the state of a digital input

Syntax TEC:DIO:IN? *port*

Details Returns the state of a specific digital input port.

Argument	Value	Description
port	0	Interlock
	1 to max	Digital input pin

The return value will be zero if in the input is low (or interlock is shorted), 1 if the input is high (or the interlock is open). An unconnected digital input may be high or low, depending on the electrical configuration of the port. See the user's manual for more details.

Only supported on instruments that feature digital input capability.

See Also TEC:INMODE

TEC:DIO:INMODE

Synopsis Set the digital input mode

Syntax TEC:DIO:INMODE *port, function [,invert]*

Details Selects the *function* and *invert* setting for a specific input port. Input ports can be used as additional interlocks (function 1), or to remotely control the on/off state of the instrument (function 2). The *invert* setting is used to control if the function is active when the pin is high (invert 0) or when the pin is low (invert 1).

Argument	Value	Description
port	0	Interlock input
	1 to max	Digital input pin
function	0	Monitor only (no function)
	1	Interlock
	2	Output On
invert	0	No logic inversion (function is active high)
	1	Inverted logic (function is active low)

Only supported on instruments that feature digital input capability.

See Also TEC:INMODE

TEC:DIO:INMODE?

Synopsis Query the digital input mode

Syntax TEC:DIO:INMODE? *port*

Details Returns the input mode and invert setting for a specific input port. See TEC:INMODE for a definition of the *port* argument and *function* and *invert* response values.

Only supported on instruments that feature digital input capability.

See Also TEC:INMODE

TEC:DIO:OUT?

Synopsis Query the state of a digital output

Syntax TEC:DIO:OUT? *port*

Details Returns the state of a specific digital output port.

Argument	Value	Description
port	0	Relay
	1 to max	Digital output pin

The return value will be zero if in the output is low (or the relay is open), 1 if the output is high (or the relay is closed).

Only supported on instruments that feature digital output capability.

See Also TEC:INMODE

TEC:DIO:OUTMODE

Synopsis Set the digital input mode

Syntax TEC:DIO:OUTMODE *port, function [,invert]*

Details Selects the *function* and *invert* setting for a specific output port. Output ports can be used to signal various instrument states or directly controlled. The *invert* setting is used to control if the pin is set to high function is active (invert 0) or low (invert 1). The relay only supports an invert setting of zero.

Argument	Value	Description
port	0	Relay
	1 to max	Digital output pin
function	0	Pin output low (off)
	1	Pin output high (on)
	2	Output on
	3	Temperature stable
	4	Temperature limit
	5	Current limit
	6	Remote mode
invert	0	No logic inversion (pin is high if function is active)
	1	Inverted logic (pin is low if function is active)

The *invert* setting is ignored when the *function* is 0 or 1.

Only supported on instruments that feature digital output capability.

See Also TEC:OUTMODE

TEC:DIO:OUTMODE?

Synopsis Query the digital output mode

Syntax TEC:DIO:OUTMODE? *port*

Details Returns the output mode and invert setting for a specific output port. See TEC:OUTMODE for a definition of the *port* argument and *function* and *invert* response values.

Only supported on instruments that feature digital output capability.

See Also TEC:OUTMODE

TEC:DISplay

Synopsis Set the display enable state

Syntax TEC:DISplay *enable*

Details The TEC:DISplay command can be used to completely lock out local operation of the instrument and display "Display Disabled" instead of the normal display.

Argument	Value	Description
enable	0	Disables the display and front panel
	1	Enables the display and front panel

Once the display is disabled, the front panel is completely locked out. The only way to restore functionality to the front panel is to issue a "TEC:DISplay 1" or cycle power on the unit.

See Also TEC:DISplay?

TEC:DISplay?

Synopsis Query the display enable state

Syntax TEC:DISplay?

Details Returns the value of the TEC display enable state. See TEC:DISplay for a definition of the *enable* response value.

See Also TEC:DISplay

TEC:ENABle:AUXLIMITS

Synopsis Enable or disable the use of auxiliary temperature limits

Syntax TEC:ENABle:AUXLIMITS *enable*

Details When enabled, the auxiliary temperature sensor limits become active, and if the measurement exceeds its high or low limit, a corresponding temperature high or low limit condition will be generated. Depending on the setting in the Output Off Enable register, this can then shut down the output.

Argument	Value	Description
enable	0	Disable auxiliary temperature sensor limits
	1	Enables auxiliary temperature sensor limits

See Also TEC:ENABLe:AUXLIMITS?, TEC:THI, TEC:TLO

TEC:ENABle:AUXLIMITS?

Synopsis Query the state of the auxiliary temperature limit enable

Syntax TEC:ENABle:AUXLIMITS?

Details Returns the state of auxiliary temperature limit enable. See the TEC:ENABle:AUXLIMITS command for a definition of *enable* response.

See Also TEC:ENABLe:AUXLIMITS

TEC:ENABle:COND

Synopsis Set TEC Condition Enable register

Syntax TEC:ENABle:COND *conditions*

Details Enables reporting of selected conditions to the Status Byte Register. See the TEC:COND command for a definition of the *conditions* parameter. The default value for this register is 0.

See Also TEC:ENABLe:COND?, TEC:COND?

TEC:ENABle:COND?

Synopsis Query TEC Condition Enable register

Syntax TEC:ENABle:COND?

Details Returns the value of the TEC Condition Enable register. See the TEC:COND command for a definition of the *conditions* response.

See Also TEC:ENABLe:COND, TEC:COND?

TEC:ENABle:EVEnt

Synopsis Set TEC Event Enable register

Syntax TEC:ENABle:EVEnt *events*

Details Enables reporting of selected events to the Status Byte Register. See the TEC:EVEnt command for a definition of the *events* parameter. The default value for this register is 0.

See Also see also TEC:ENABle:EVEnt?; TEC:EVE?

TEC:ENABle:EVEnt?

Synopsis Query TEC Event Enable register

Syntax TEC:ENABle:EVEnt?

Details Returns the value of the TEC Event Enable register. See the TEC:EVEnt command for a definition of the *events* response.

See Also TEC:ENABLe:EVEnt, TEC:EVEnt?

TEC:ENABle:NONACTIVELIMITS

Synopsis Enable or disable the use of temperature limits for non-active primary sensors

Syntax TEC:ENABle:NONACTIVELIMITS *enable*

Details When enabled, the temperature sensor limits for non-active primary sensors become active, and if the measurement exceeds its high or low limit, a corresponding temperature high or low limit condition will be generated. Depending on the setting in the Output Off Enable register, this can then shut down the output.

Argument	Value	Description
enable	0	Disable non-active primary temperature sensor limits
	1	Enables non-active primary temperature sensor limits

See Also TEC:ENABLe:NONACTIVELIMITS?, TEC:THI, TEC:TLO

TEC:ENABle:NONACTIVELIMITS?

Synopsis Query the state of the temperature limits for non-active primary sensors

Syntax TEC:ENABle:NONACTIVELIMITS?

Details Returns the state of temperature limits for non-active primary sensors enable. See the TEC:ENABle:NONACTIVELIMITS command for a definition of *enable* response.

See Also TEC:ENABLe:NONACTIVELIMITS

TEC:ENABle:OUTOFF

Synopsis Set the Output Off Enable register

Syntax TEC:ENABle:OUTOFF *outoff*

Details The Output Off register controls what conditions will cause the TEC output to be turned off.

Argument	Bit	Value	Description
outoff	0	1	Current limit
	1	2	Voltage limit
	2	4	Sensor limit
	3	**8**	**Temperature high limit**
	4	**16**	**Temperature low limit**
	5	32	Unused
	6	**64**	**Sensor open**
	7	**128**	**TEC open circuit**
	8	256	Unused
	9	512	Out of tolerance
	10	**1024**	**Sensor short**
	11	2048	Unused
	12	4096	Unused
	13	8192	Unused
	14	16384	Unused
	15	32768	Unused

Bold elements indicate default settings. In earlier versions of firmware, bit 8 was “Sensor type changed” and always enabled, but was removed in versions 3.0 and beyond.

The default value for this register is 1240 for firmware versions 3.0 and beyond, and 1496 for earlier versions of firmware.

See Also TEC:ENABle:OUTOFF?

TEC:ENABle:OUTOFF?

Synopsis Query the Output Off Enable register

Syntax TEC:ENABle:OUTOFF?

Details Returns the value of the Output Off register. See the TEC:ENABle:OUTOFF command for definition of *outoff* response value.

See Also TEC:ENABle:OUTOFF

TEC:EVEnt?

Synopsis Query the TEC event register

Syntax TEC:EVEnt?

Details Returns the TEC event register.

Response	Bit	Value	Description
events	0	1	Current limit
	1	2	Voltage limit
	2	4	Sensor limit
	3	8	Temperature high limit
	4	16	Temperature low limit
	5	32	Sensor shorted
	6	64	Sensor open
	7	128	TEC open circuit
	8	256	Unused
	9	512	Out of tolerance changed state
	10	1024	Output changed state
	11	2048	Unused
	12	4096	Unused
	13	8192	Unused
	14	16384	Unused
	15	32768	Unused

After reading the event register, the event register is set to zero.

See Also TEC:ENABle:EVEnt

TEC:FAN

Synopsis Set the external fan speed

Syntax TEC:FAN *speed[, mode[, delay]]*

Details Set the external fan speed.

Argument	Value	Description
speed	OFF, SLOW, MEDIUM, FAST, or 4.0 to 12.0	Fan speed
mode	1, 2, or 3	Fan delay mode: 1 = Auto (fan off when TEC off) 2 = On (fan always on) 3 = Delayed off (fan turns off *delay* minutes after TEC turned off). 4 = Cool only (fan operates only when TEC is cooling) 5 = Heat only (fan operates only when TEC is heating)
delay	1 to 240	Minutes to delay turning fan off (only applies to 'Delayed off' *mode*.

The values SLOW, MEDIUM, and FAST correspond to 9V, 10.5V, and 12V, respectively. The fan speed can also be controlled by selecting a specific voltage to drive the fan. When using external fan control, ensure your fan and voltage setting are properly match, or damage to the fan may occur.

Setting the *mode* to 1 will turn the fan off whenever the output is off. Setting the *mode* to 2 will turn the fan on always, regardless of the TEC output state. Setting the *mode* to 3 will delay the turning off of the fan to *delay* minutes after the TEC output is turned off.

The *delay* setting only applies when *mode* is set to 3 (delayed off), and sets the number of minutes to delay the fan from turning off after the output has been turned off.

The 5230 does not support the FAN setting.

See Also TEC:FAN?

TEC:FAN?

Synopsis Query the external fan speed setting

Syntax TEC:FAN?

Details Returns the fan speed setting. See TEC:FAN for a definition of the *speed, mode, and delay* response values.

See Also TEC:FAN

TEC:GAIN

Synopsis Set the control loop gain

Syntax TEC:GAIN *gain*

Details Set the temperature control loop gain.

Argument	Value	Description
gain	1, 3, 5, 10, 30, 50, 100 ,300, PID	TEC gain

The 5230 does not support the PID setting.

See Also TEC:GAIN?; TEC:PID

TEC:GAIN?

Synopsis Query the control loop gain

Syntax TEC:GAIN?

Details Returns the value of control loop gain. See TEC:GAIN for a definition of the *gain* response value.

See Also TEC:GAIN; TEC:PID

TEC:HEATCOOL

Synopsis Set the heat/cool mode

Syntax TEC:HEATCOOL *mode*

Details Sets the heat/cool mode.

Argument	Value	Description
mode	BOTH	Heat and cool
	HEAT	Heat only
	COOL	Cool only

The 5230 does not support the HEATCOOL setting.

See Also TEC:HEATCOOL?

TEC:HEATCOOL?

Synopsis Query the heat/cool mode

Syntax TEC:HEATCOOL?

Details Returns the heat/cool mode setting. See TEC:HEATCOOL for a definition of the *mode* response value.

See Also TEC:HEATCOOL

TEC:INC

Synopsis Increment the TEC set point

Syntax TEC:INC *steps*

Details The TEC: INC command uses the step size defined with the TEC:STEP command to increment the TEC set point. The set point is incremented *steps* times the step size.

Argument	Value	Description
steps	1 to 65000	Number of steps to increment

See Also TEC:DEC, TEC:STEP

TEC:ITE

Synopsis Set the TEC current set point

Syntax TEC:ITE *setpoint*

Details Sets the TEC current set point. It must be within the current limit.

Argument	Description
setpoint	Current set point, in amps

Not available in 5230 TECSource.

See Also TEC:SET:ITE?, TEC:ITE?

TEC:ITE?

Synopsis Query the TEC current

Syntax TEC:ITE?

Details The TEC:ITE? Query returns the measured TEC current.

Response	Value	Description
ite	$\pm ITE_{lim}$	Measure TEC current, in amps

See Also TEC:LIMit:ITE

TEC:INVERTITE

Synopsis Controls the ITE invert setting

Syntax TEC:INVERTITE *invert*

Details Changes (inverts) the polarity of the ITE current.

Argument	Value	Description
invert	0	Normal polarity
	1	Inverted polarity

See Also TEC:INVERTITE?

Support This function is only available in firmware version 2.0 and later.

TEC:INVERTITE?

Synopsis Query the state of the ITE inversion

Syntax TEC:INVERTITE?

Details Returns the ITE inversion setting. See TEC:INVERTITE for a definition of the *invert* response value.

See Also TEC:INVERTITE

Support This function is only available in firmware version 2.0 and later.

TEC:LIMit:ITE

Synopsis Set the TEC current limit

Syntax TEC:LIMit:ITE *limit*

Details Sets the TEC current limit.

Argument	Value	Description
limit	$\pm ITE_{max}$	TEC current limit, in amps

See Also TEC:ITE?, TEC:LIMit:ITE?

TEC:LIMit:ITE?

Synopsis Query the TEC current limit

Syntax TEC:LIMit:ITE?

Details Returns the value of the TEC current limit. See TEC:LIMit:ITE for a definition of the *limit* response value.

See Also TEC:LIMit:ITE

TEC:LIMit:RHI

Synopsis Set the high sensor limit

Syntax TEC:LIMit:RHI *limit*

Details Sets the high sensor limit.

Argument	Description
limit	High sensor limit: Thermistors in kΩ AD590s in μA LM335s in mV RTDs in Ω

See Also TEC:LIMit:RHI?

TEC:LIMit:RHI?

Synopsis Query the high sensor limit

Syntax TEC:LIMit:RHI?

Details Returns the value of the high sensor limit. See TEC:LIMit:RHI for a definition of the *limit* response value.

See Also TEC:LIMit:RHI

TEC:LIMit:RLO

Synopsis Set the low sensor limit

Syntax TEC:LIMit:RLO *limit*

Details Sets the low sensor limit.

Argument	Description
limit	Low sensor limit: Thermistors in kΩ AD590s in μA LM335s in mV RTDs in Ω

See Also TEC:LIMit:RLO?

TEC:LIMit:RLO?

Synopsis Query the low sensor limit

Syntax TEC:LIMit:RLO?

Details Returns the value of the low sensor limit. See TEC:LIMit:RLO for a definition of the *limit* response value.

See Also TEC:LIMit:RLO

TEC:LIMit:THI

Synopsis Set the high temperature limit

Syntax TEC:LIMit:THI *limit* [*, sensor index*]

Details Sets the high temperature limit. If the optional *sensor index* argument is omitted, the active sensor is used.

Argument	Value	Description
limit	-99 to +250	High temperature limit, in degrees
sensor index	1 to max	Sensor index

See Also TEC:LIMit:THI?

TEC:LIMit:THI?

Synopsis Query the high temperature limit

Syntax TEC:LIMit:THI? [*sensor index*]

Details Returns the value of the high temperature limit. If the optional *sensor index* argument is omitted, the active sensor is used. See TEC:LIMit:THI for a definition of *sensor index argument* and the *limit* response value.

See Also TEC:LIMit:THI

TEC:LIMit:TLO

Synopsis Set the low temperature limit

Syntax TEC:LIMit:TLO *limit*

Details Sets the low temperature limit. If the optional *sensor index* argument is omitted, the active sensor is used.

Argument	Value	Description
limit	-99 to +250	Low temperature limit, in degrees
sensor index	1 to max	Sensor index

See Also TEC:LIMit:TLO?

TEC:LIMit:TLO?

Synopsis Query the low temperature limit

Syntax TEC:LIMit:TLO? [*sensor index*]

Details Returns the value of the low temperature limit. If the optional *sensor index* argument is omitted, the active sensor is used. See TEC:LIMit:TLO for a definition of *sensor index argument* and the *limit* response value.

See Also TEC:LIMit:TLO

TEC:MODE?

Synopsis Query the TEC control mode

Syntax TEC:MODE?

Details Returns the TEC control mode.

Response	Value	Description
mode	T	Temperature control mode
	R	Sensor control mode
	ITE	Current control mode

See Also TEC:MODE:R, TEC:MODE:T; TEC:MODE:ITE

TEC:MODE:ITE

Synopsis Set current control mode

Syntax TEC:MODE:ITE

Details Changes the set point to amps and sensor measurement to degrees Celsius.

Not available in 5230 TECSource.

See Also TEC:MODE?, TEC:MODE:T;TEC:MODE:R

TEC:MODE:R

Synopsis Set sensor control mode

Syntax TEC:MODE:R

Details Changes the set point and sensor measurement to ohms.

See Also TEC:MODE?, TEC:MODE:T, TEC:MODE:ITE

TEC:MODE:T

Synopsis Set temperature control mode

Syntax TEC:MODE:T

Details Changes the set point and sensor measurement to degrees Celsius.

See Also TEC:MODE?, TEC:MODE:R, TEC:MODE:ITE

TEC:MOUNT

Synopsis Set the mount type

Syntax TEC:MOUNT *mount*

Details Set the mount type to preset controller to mount's operating parameters.

Argument	Value	Description
mount	204, 205, 207, 207-150, 214, 215, 224, 226, 234, 242, 264, 264-150, 274, 284, 284-150, 286, 286-150, or USER	Mount type

Not available in 5230 TECSource. The above list of mounts will expand as new mounts are added.

See Also TEC:MOUNT?

TEC:MOUNT?

Synopsis Query the mount type

Syntax TEC:MOUNT?

Details Returns the mount type. See TEC:MOUNT for a definition of the *mount* response value.

See Also TEC:MOUNT

TEC:OUTput

Synopsis Set the TEC output state

Syntax TEC:OUTput *state*

Details Turns the TEC output on or off.

Argument	Value	Description
state	0	Turn the output off
	1	Turn the output on

See Also TEC:OUTput?

TEC:OUTput?

Synopsis Query the TEC output state

Syntax TEC:OUTput?

Details Returns the TEC output state. See TEC:OUT for a definition of the *state* response value.

See Also TEC:OUTput

TEC:PID

Synopsis Sets the PID parameters

Syntax TEC:PID *p [,I [,d]]*

Details Sets PID parameters of the control loop when the GAIN is set to PID.

Argument	Description
p	The Proportional term, can be from 0 to 10
i	The Integral term, can be from 0 to 10
d	The Derivative term, can be from 0 to 10

The *i* and *d* values can be omitted, such that value commands might be:

```
TEC:PID 1
TEC:PID 1,2
TEC:PID 1,2,3
```

But the following is not valid:

```
TEC:PID 1,,3
```

See Also TEC:PID?, TEC:GAIN

TEC:PID?

Synopsis Queries the TEC PID parameters

Syntax TEC:PID?

Details Returns the TEC PID parameters used when GAIN is set to PID.

See Also TEC:PID, TEC:GAIN

TEC:R

Synopsis Set the sensor set point

Syntax TEC:R *setpoint*

Details Sets the sensor set point. It must be within the low and high sensor limits.

Argument	Description
setpoint	Sensor set point: Thermistors in kΩ AD590s in μA LM335s in mV RTDs in Ω

See Also TEC:SET:R?

TEC:R?

Synopsis Query the actual sensor value

Syntax TEC:R? *[sensor index]*

Details Returns the actual (measured) sensor value. If the optional *sensor index* argument is omitted, the active sensor is used.

Argument	Value	Description
sensor index	1 to 7	Sensor index

Response	Value	Description
sensor value		Actual sensor value: Thermistors in kΩ AD590s in μA LM335s in mV RTDs in Ω

See Also TEC:T

TEC:SENsor

Synopsis Set the sensor type

Syntax TEC:SENsor *sensor [, sensor index]*

Details Sets the sensor type. Note that a sensor type of 0 (disabled) can only be selected on non-active sensors. If the optional *sensor index* argument is omitted, the active sensor is used.

Argument	Value	Description
sensor	0	Disabled
	1	100uA Thermistor
	2	10uA Thermistor
	3	LM335
	4	AD590
	5	RTD
	6	RTD (4-wire sense)
	7	1mA Thermistor
sensor index	1 to max	Sensor index

The *sensor index* value is only valid on instruments with multiple sensor inputs, such as the 5400.

The 5230 only supports the 10uA Thermistor setting (TEC:SENS 2). Any other value will generate an error.

See Also TEC:SENsor?

TEC:SENsor?

Synopsis Query the sensor type

Syntax TEC:SENsor? *[sensor index]*

Details Returns the active sensor. See the TEC:SENsor command for a definition of the *sensor index argument* and *sensor* response.

See Also TEC:SENsor

TEC:SET:ITE?

Synopsis Query current set point

Syntax TEC:SET:ITE?

Details Returns the current set point. See TEC:ITE for a definition of the *setpoint* response value.

Not available in 5230 TECSource.

See Also TEC:ITE

TEC:SET:R?

Synopsis Query sensor set point

Syntax TEC:SET:R?

Details Returns the sensor set point. See TEC:R for a definition of the *setpoint* response value.

See Also TEC:R

TEC:SET:T?

Synopsis Query temperature set point

Syntax TEC:SET:T?

Details Returns the temperature set point. See TEC:T for a definition of the *setpoint* response value.

See Also TEC:T

TEC:STB?

Synopsis Query the TEC status byte

Syntax TEC:STB?

Details Returns a summary of the enabled conditions within the TEC condition and event registers. These bits mirror the bits in the Status Byte Register.

Response	Bit	Value	Description
status	0	1	Event status register summary
	1	2	Condition status register summary

The values are additive, so a return value of 0, 1, 2, or 3 is possible.

See Also *STB?, TEC:COND?, TEC:ENAB:COND, TEC:ENABle:EVENT, TEC:EVEnt?

TEC:STEP

Synopsis Set TEC step size

Syntax TEC:STEP *size*

Details The command sets the TEC step size used by the TEC:DEC or TEC:INC commands.

Argument	Value	Description
size	1 to 65000	Step size

The *size* value corresponds to the resolution of the set point, regardless of control mode or sensor. For example, if the temperature resolution is 0.01°C, then a step of 1 would mean a change of 0.01°C. Likewise, for example, RTDs, which typically have a display resolution of 0.01Ω, a step of one would mean a change of 0.01Ω.

See Also TEC:DEC, TEC:INC, TEC:STEP?

TEC:STEP?

Synopsis Query TEC step size

Syntax TEC:STEP?

Details Returns the TEC step size. See TEC:STEP for a definition of the *size* response value.

See Also TEC:STEP

TEC:T

Synopsis Set the temperature set point

Syntax TEC:T *setpoint*

Details Sets the temperature set point. It must be within the low and high temperature limits.

Argument	Description
setpoint	Temperature set point, in degrees Celsius

See Also TEC:SET:T?, TEC:TRATE

TEC:T?

Synopsis Query the actual temperature

Syntax TEC:T? *[sensor index]*

Details Returns the actual (measured) sensor temperature. If the optional *sensor index* argument is omitted, the active sensor is used.

Argument	Description
sensor index	Sensor index

Response	Description
temperature	Actual sensor temperature, in degrees Celsius

See Also TEC:T

TEC:TOLerance

Synopsis Set the TEC tolerance criteria

Syntax TEC:TOLerance *tolerance, time*

Details The TEC:TOLerance command allows control over when the output of the temperature controller is considered in tolerance (or stable), in order to satisfy the tolerance condition of the operation complete definition. When used in conjunction with the *WAI command, it can control when the next command is processed, delaying processing until the output stabilizes at its set point.

Argument	Value	Description
tolerance	0.01 to 10	Tolerance, in °C
time	0.1 to 50	Time window in seconds

To be considered in tolerance, the measured temperature must be within the set point plus or minus the *tolerance* value (the tolerance window) for *time* seconds. Any time it leaves the tolerance window, the timer will reset to zero and begin counting the next time it enters the tolerance window.

In sensor control mode, the *tolerance* is fixed at 0.01kΩ (100μA thermistor), 0.1kΩ (10μA thermistor), 0.1μA (AD590), 1mV (LM335), and 0.1Ω (RTD).

See Also TEC:TOLerance?

TEC:TOLerance?

Synopsis Query the TEC tolerance criteria

Syntax TEC:TOLerance?

Details Returns the value of the TEC tolerance criteria. See TEC:TOLerance for a definition of the *tolerance* and *time* response values.

See Also TEC:TOLerance

TEC:TRATE

Synopsis Set the target temperature slew rate

Syntax TEC:TRATE *rate*

Details Sets the desired temperature slew rate. Set to 0 to disable, or to a maximum of 100°C/minute.

Argument	Description
rate	Temperature slew rate, in degrees Celsius per minute

Not supported on all instruments.

See Also TEC:SET:T?

TEC:TRATE?

Synopsis Query the target temperature slew rate set point

Syntax TEC:TRATE?

Details Returns the slew rate as set by the TEC:TRATE command.

Response	Description
rate	Temperature slew rate, in degrees Celsius per minute

Not supported on all instruments.

See Also TEC:T

TEC:TSTEP

Synopsis Set the temperature set point step size

Syntax TEC:TSTEP *step size*

Details Sets the desired temperature step size. Does not affect temperature set points sent via the TEC:T command, only the size of the change for each tick of the adjustment knob on the front panel.

Argument	Value	Description
step size	1	0.001°C per knob tick
	2	0.005°C per knob tick
	3	0.01°C per knob tick
	4	0.05°C per knob tick
	5	0.1°C per knob tick
	6	0.5°C per knob tick
	7	1°C per knob tick
	8	5°C per knob tick
	9	10°C per knob tick

Step size cannot be set below the measurement resolution of the instrument. For example, if the temperature measurement resolution is 0.01°C, the smallest allowable step size is 0.01.

See Also TEC:TSTEP?

TEC:TSTEP?

Synopsis Query the temperature set point step size

Syntax TEC:TSTEP?

Details Returns the temperature *step size* index. See TEC:TSTEP for a definition of the *step size* return value.

See Also TEC:TSTEP

TEC:USERCAL:EDIT

Synopsis Enable or disabled user calibration editing

Syntax TEC:USERCAL:EDIT *enable*

Details Sets the edit enable state for user calibration. A TEC:USERCAL:PUT command will fail until the editing is enabled with this command.

Argument	Value	Description
enable	0	User calibration editing disabled
	1	User calibration editing enabled

See Also TEC:USERCAL:EDIT?, TEC:USERCAL:PUT

Support This function is only available in firmware version 1.30 and later.

TEC:USERCAL:EDIT?

Synopsis Query the state of the user calibration edit enable flag

Syntax TEC:USERCAL:EDIT?

Details Returns 0 if user calibration editing is disabled, and 1 if user calibration editing is enabled.

See Also TEC:USERCAL:EDIT

Support This function is only available in firmware version 1.30 and later.

TEC:USERCAL:GET?

Synopsis Query a TEC USERCAL setting

Syntax TEC:USERCAL:GET? *index [, sensor index]*

Details Returns the slope and offset compensation values for a specific user calibration *index*. See TEC:USERCAL:PUT for a definition of the *index* and *sensor index* arguments and *slope* and *offset* response values.

See Also TEC:USERCAL:PUT

Support This function is only available in firmware version 1.30 and later. Only limited indexes are available in pre-2.0 firmware (indexes 4, 5, 9, and 10). For version 1.xx firmware, see the controller's manual for details on for the calibration data is managed.

TEC:USERCAL:GETALL?

Synopsis Query all TEC USERCAL settings

Syntax TEC:USERCAL:GETALL? *add terminator*

Details Returns the slope and offset compensation values for all user calibration indexes. If *add terminator* is non-zero, command terminator (CR, LF, or CR/LF) will be sent after each index. See LASer:USERCAL:PUT for a definition of the *index* argument and *slope* and *offset* response values.

See Also TEC:USERCAL:PUT

Support This function is only available in firmware version 1.30 and later.

TEC:USERCAL:PUT

Synopsis Sets a USERCAL value

Syntax TEC:USERCAL:PUT *index, slope, offset [, sensor index]*

Details The command sets the user calibration setting for a specific *index,* allowing for user compensation of measurements or set points. The default value for all slopes is 1, and the default value for all offsets is 0.

Compensation is applied according to the following formula:

*compensated = slope * uncompensated + offset*

Argument	Value	Description
index	1	ITE set point
	2	ITE measurement*
	3	VTE measurement*
	4	Thermistor 10µA measurement
	5	Thermistor 100µA measurement
	6	Thermistor 1mA measurement
	7	LM335 measurement
	8	AD950 measurement
	9	RTD measurement
	10	RTD 4-wire measurement
	12	VTE 4-wire measurement*
	13	Analog output set point
slope	*0.5 to 1.5*	Slope compensation
offset		Offset compensation
sensor index	1 to max	Sensor index

TEC:USERCAL:PUT is only supported on certain instruments. Not all indexes are supported in every instrument. See your user's manual for details on what measurements are supported.

* When calibrating ITE measurement, VTE measurement, or VTE 4-wire measurement, use positive currents/voltages during the calibration process.

You must enable editing of user calibration values with the TEC:USERCAL:EDIT command.

See Also TEC:USERCAL:EDIT, TEC:USERCAL:GET?

Support This function is only available in firmware version 1.30 and later. Only limited indexes are available in pre-2.0 firmware (indexes 4, 5, 9, and 10). For version 1.xx firmware, see the controller's manual for details on how the calibration data is managed.

TEC:USERCAL:RESET

Synopsis Resets all TEC user calibration settings to factory defaults

Syntax TEC:USERCAL:RESET

Details Resets all TEC user calibration slopes to 1 and all offsets to 0.

See Also TEC:USERCAL:EDIT

Support This function is only available in firmware version 1.30 and later.

TEC:V?

Synopsis Query the actual TEC voltage

Syntax TEC:V?

Details Returns the actual (measured) TEC voltage.

Response	Description
voltage	Actual TEC voltage, in volts

See Also TEC:T

TEC:VSENSE

Synopsis Select local or remote voltage sense

Syntax TEC:VSENSE *select*

Details For instruments that support selectable local/remote voltage sense, this command selects local or remote sense.

Argument	Value	Description
select	0	Local voltage sense
	1	Remote voltage sense

See Also TEC:VSENSE?

Support Only supported on instrument equipped with 4-wire voltage sense capability. See your controller's manual for more details.

TEC: VSENSE?

Synopsis Queries the voltage sense selection.

Syntax TEC:VSENSE?

Details For instruments that support selectable local/remote voltage sense, this command returns the *select* value. See the TEC:VSENSE command for more information.

See Also TEC:VSENSE

Support Only supported on instrument equipped with 4-wire voltage sense capability. See your controller's manual for more details.

TERM

Synopsis Set response terminator

Syntax TERM *terminator*

Details This command controls the termination characters used for responses to queries.

Argument	Value	Description
terminator	0 or 1	<CR><LF>
	2 or 3	<CR>
	4 or 5	<LF>
	6 or 7	no terminator

See Also TERM?

TERM?

Synopsis Query response terminator

Syntax TERM?

Details Returns the current response terminator setting. See the TERM command for a complete definition of possible return values.

See Also TERM

TERMINAL

Synopsis Set terminal mode

Syntax TERMINAL *enable*

Details The command controls the echo of characters back to the PC, typically used when manually controlling the instrument via a terminal software package such as Hyperterminal.

Argument	Value	Description
enable	0	Echo disabled
	1	Echo enabled

See Also TERMINAL?

TERMINAL?

Synopsis Query terminal mode

Syntax TERMINAL?

Details Returns the current response terminal mode setting. See the TERMINAL command for a complete definition of possible return values.

See Also TERMINAL

TIME?

Synopsis Query run time

Syntax TIME?

Details Returns the elapsed time since the unit has been turned on. Format is in HH:MM:SS.ss, where HH is hours, MM is minutes, SS is seconds, and ss is hundredths of a second.

See Also TIMER?

TIMER?

Synopsis Query time since last TIMER?

Syntax TIMER?

Details Returns the elapsed time since the last TIMER? query was received, or, if this is the first TIMER? query, the time since unit has been turned on. Format is in HH:MM:SS.ss, where HH is hours, MM is minutes, SS is seconds, and ss is hundredths of a second.

See Also TIME?

VER?

Synopsis Query the firmware version

Syntax VER?

Details Returns the firmware version. This is the same information that is part of the *IDN? query.

See Also *IDN?

Error Messages

Error Code	Description	Cause
E-003	Factory EEPROM Error	The factory section of the EEPROM, which contains the calibration data and system configuration systems, is corrupted. The unit must be returned to the factory for repair.
E-004	User EEPROM Error	The user settings section of the EEPROM, which contains user editable set points, modes, etc., is corrupted. To repair the corruption, the unit was reset to factory defaults.
E-005	User Reset EEPROM	The user reset the unit to factory defaults. This is a notification message only.
E-006	User EEPROM Failed	The user settings section of the EEPROM, which contains user editable set points, modes, etc., is corrupted. The corruption cannot be repaired automatically, please contact the factory for assistance.
E-007	Preset EEPROM Failed	The preset settings section of the EEPROM, which contains user section defaults, is corrupted. The corruption cannot be repaired automatically, please contact the factory for assistance.
E-008	User EEPROM Failed	The user settings section of the EEPROM, which contains user editable set points, modes, etc., is corrupted, and the preset section cannot restore it. The corruption cannot be repaired automatically, please contact the factory for assistance.
E-009	Output Disabled	Added to every ERR? or ERRSTR? query when the EEPROM is corrupted. The output cannot be turned on until the corruption has been repaired.
E-100	General Error	The error code is non-specific, and is generally used when no other error code is suitable.
E-102	Message too long	The message is too long to process (USB/Serial only).
E-104	Type not allowed	The RADix type was invalid
E-123	Path not found	The message used an invalid path command (USB/Serial only).
E-124	Data mismatch	The message contained data that did not match the expected format (USB/Serial only).
E-126	Too few or too many elements	The command requires more or less than the number of parameters actually supplied.
E-127	Change not allowed	An attempt was made to change a parameter that cannot be changed, or is currently read-only.
E-201	Data out of range	The message attempted to set a value that was outside the allowable range (USB/Serial only).
E-202	Invalid data type	When trying to parse the message, the data was in an invalid format (USB/Serial only).
E-204	Suffix not valid	An invalid number base suffix (radix) was encountered when parsing a number (USB/Serial only).
E-217	Configuration Recall failed	An attempt recall a configuration failed. This can be caused if no configuration exists in the selected slot, the slot number is out of range, or if the configuration is corrupted.
E-218	Configuration Save failed	At attempt to save a configuration failed. This can be caused if the slot number is out of range, or the configuration memory is corrupted.
E-220	Script Save Failed	At attempt to save a script failed. This can be caused if the script number is out of range, or the script memory is corrupted.
E-221	Cannot embed script	A script was executed that contained a reference to another script.
E-222	Cannot execute script	At attempt to save a script failed. This can be caused if the script number is out of range, no script exists for the selected index, or the script memory is corrupted.
E-303	Input buffer overrun	The command input buffer overran, which can be caused by excessively long command strings or improperly terminated commands.

Error Code	Description	Cause
E-402	Sensor open, output turned off	A sensor open circuit was detected and the output was turned off.
E-403	Module open, output turned off	A Peltier module open circuit was detected and the output was turned off.
E-404	I limit, output turned off	A current limit was detected and the output was turned off.
E-405	V limit, output turned off	A voltage limit was detected and the output was turned off.
E-406	Thermistor resistance limit, output turned off	The thermistor resistance limit (high or low) was exceeded and the output was turned off.
E-407	Temperature limit, output turned off	The temperature limit (high or low) was exceeded and the output was turned off.
E-409	Sensor change, output off	The sensor was changed while the output was on, forcing the output off.
E-410	Temperature was out of tolerance, output turned off	The temperature went out of tolerance and the output was turned off.
E-415	Sensor short, output turned off	A sensor short circuit was detected and the output was turned off.
E-416	Calibration failure	The calibration process failed due to improper setup, an interfering action (set point change, output on/off), or unexpected results.
E-419	TEC not stable	The TEC is considered stable if the temperature has changed less than 0.02°C for more than 20 seconds.
E-433	Not a TEC	The TEC:CHAN command attempted to select a non-TEC channel
E-434	Ite limit exceeds cable rating	The cable plugged into the unit cannot carry the current as limited by the Ite Limit setting. Lower the Ite limit to the cables capacity, or use a higher capacity cable.
E-435	Mode change	A mode change occurred when the output was on, forcing the output off.
E-436	AutoTune Failed	The AutoTune process failed.
E-437	AutoTune Required T Mode	The AutoTune process was cancelled because the instrument was not in T mode.
E-438	Thermal Trip	The thermal limit of the heat sink was reached, output turned off.
E-450	TECPak analog set disconnected	An attempt to turn on the TEC output was prevented because the instrument was configured to use the analog set point input and no analog set point was detected.
E-501	Interlock shutdown output	The interlock was open when the output was on (or was attempting to turn on).
E-504	Laser current limit disabled output.	The laser output was turned off because a current limit was detected and the corresponding bit in the OUTOFF register was set.
E-505	Laser voltage limit disabled output	The laser voltage exceeded the voltage limit and the output was turned off.
E-506	Laser photodiode current limit disabled output	The laser output was turned off because a photodiode current limit was detected and the corresponding bit in the OUTOFF register was set.
E-507	Laser photodiode power limit disabled output	The laser output was turned off because a photodiode power limit was detected and the corresponding bit in the OUTOFF register was set.
E-508	TEC off disabled output	The laser output was turned off because the TEC was off and the corresponding bit in the OUTOFF register was set.
E-509	Laser short circuit disabled output	The laser output was turned off because a short condition was detected and the corresponding bit in the OUTOFF register was set.
E-510	Laser out of tolerance disabled output	The laser output was turned off because an out-of-tolerance condition was detected and the corresponding bit in the OUTOFF register was set.
E-511	Laser control error disabled output	A hardware control error was detected which forced a shutdown of the laser output.
E-512	Power failure	A power failure was detected.
E-514	Laser mode change disabled output	A change in the operating mode of the Laser driver while the output was on shutdown the output.

Error Code	Description	Cause
E-516	Incorrect configuration for calibration to start	The Laser driver was not configured properly, including the mode and output on state, to be able to start the desired calibration process.
E-517	Calibration must have the output on to start	The laser output must be on for the calibration process to start.
E-521	TEC temperature limit disabled output	The laser output was turned off because the TEC temperature limit was exceeded and the corresponding bit in the OUTOFF register was set.
E-534	Po mode selected with PD Response set to zero	Attempted to select Po mode and PD Response was zero, or Laser driver was in Po mode and PD Response was set to zero.
E-535	Calibration cancelled	The active calibration process was cancelled.
E-536	Intermittent contact detected	The instrument detected an intermittent contact and shut down the laser output. If this is triggering falsely (such as in a noisy environment), the intermittent contact detection can be disabled in the main menu.
E-537	Thermal Limit Exceeded	The thermal load inside the instrument is too high, and the output was shutdown to protect the instrument.
E-538	Sensor Limits Exceeded	A laser temperature sensor exceeded the resistance limits, laser output turned off.
E-539	Temperature Limits Exceeded	A laser temperature sensor exceeded the temperature limits, laser output turned off.
W-800	Remote Voltage Sense Low	Notification message only: On instruments with remote voltage sense, the remote voltage measurement is much lower than the voltage at the output connector. This is only a warning, and does not indicate an actual problem.
W-801	Burst Mode, Hold Output	Notification message only: When in Io (Burst) mode, to turn the output on, the Output button must be held down for at least one second. If it is held down for less than one second, this warning message informs the user than the Output button press did not turn the output on.
W-803	User reset to factory defaults	Notification message only: User pressed key sequence on start-up to reset unit to factory defaults.
W-805	User recall turned outputs off	Notification message only: A user configuration was recalled from memory while the outputs were on, resulting in the outputs being turned off.
W-806	No function key assigned	Notification message only: User attempted to execute a function key action that was not assigned.
E-997	Control error, cycle power	A hardware control error occurred, cycle power to resolve. If error continues to occur, contact factory.
E-992 thru E-997	Hardware error	A hardware related error occurred. If problem persists, contact factory.
E-998	Command not supported	A command was recognized but not supported by the Laser driver.
E-999	Non-specific error	A non-specific error was encountered.

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